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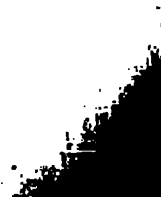
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MT. RIFENBURG.
A sand dune north of Miller's, Lake County, Indiana.

INDIANA.

DEPARTMENT

—OF—

Geology and
Natural Resources.

TWENTY-SECOND ANNUAL REPORT.

W. S. BLATCHLEY,
STATE GEOLOGIST.

1897.

INDIANAPOLIS:
WM. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING
1898.

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INTRODUCTORY.

The Natural Resources of Indiana, while not including among their number any of the precious or even useful metals, are, nevertheless, as varied in character and as valuable as those possessed by any State in the Union. In each of the last two reports issued by this Department there has been given in an introductory paper a resume of all of the State's mineral resources, while of several of the more important ones, as the sandstones, oölitic stone, petroleum, etc., detailed reports with accompanying maps and results of tests have been published.

The value of each of the five leading mineral resources of the State as produced in 1896 was as follows:

Natural Gas	\$5,043,635
Coal.....	3,946,081
Petroleum	2,954,411
Building Stone.....	1,691,341
Clay Products	2,674,325
Total	<u>\$16,309,793</u>

When, to the value of those mentioned, there be added that of the cement rock, marl, whetstone and lime rocks, curbing and flagging, molding and glass sands, and other minor mineral resources, the total will easily foot up twenty or more millions of dollars. With the exception of petroleum, the value of each of the resources produced in 1897 was increased over that of the previous year, though as yet the exact figures of all are not available to show the amount of gain.

No State in the Union, unless it be Pennsylvania, possesses at present a better and cheaper supply of fuels than does Indiana. Among the other States she ranks second in the production of natural gas, fourth in the production of petroleum and seventh in the production of coal. These three fuels are all stored products which have been formed in ages past and are not now being produced beneath the surface of our State. The citizens of Indiana are drawing upon them with a lavish hand. They not only waste them in their furnaces, their grates and their stoves by burning them at all hours and in over-abundance,

but they also allow twenty millions or more cubic feet of gas to escape daily because they are too indolent to plug or cap the wells which have been bored for oil. Indiana supplies, at ridiculously low prices, two millions of the citizens of Chicago with the greater part of the coal, gas and petroleum which they use. Individually those consumers may pay high enough for their fuels, but the producer who secures the fuels from the bowels of our noble State—or rather the middle-man who buys from the producer, pays less than one-fifth their real value. He gets his coal for 80 cents to \$1.05 per ton; his oil at 41 cents per barrel; his gas at 2 cents per thousand cubic feet. His only additional expense is for transportation, which, in the case of the oil and gas, is but a nominal sum. Those citizens of Indiana who, by right of ownership of the surface, claim the fuels which lie beneath that surface, are content to take these meagre sums because they do not know the real value of that which they are selling. Since they have not produced these fuels by the sweat of their brows, as they have their corn, oats and wheat, they do not realize their value. Surrounded as they are by the plenty of the present, it is difficult for them to realize that the time will come, and that before many years, when the stored reservoirs of at least two of these fuels within the borders of our State, will have been drained, and only the dregs be left as a reminder of the plenty that has been.

REPORT OF PROGRESS ON COAL SURVEY.—The principal work of the Department of Geology during the year 1897 was done upon the coal survey which was started the previous year and which, it is hoped, will be finished in 1898. During the field season, from the middle of April until the first of November, 1897, the following counties were surveyed: Warren, Fountain, Vermillion, Parke, Vigo, Clay, Sullivan and Greene, and those parts of Benton, Montgomery, Putnam and Owen included in the coal fields—a total of about 3,200 square miles. The field party included Messrs. G. H. Ashley, in charge, C. E. Siebenthal, E. M. Kindle and J. T. Scovell, the latter two being in the field only part of the season. Each member of the party had definite areas to work up, and will be responsible for the details of those areas. This, with the work of last season in Knox, Daviess and Martin counties, completes the field work north of the East Fork of White River, or a total area surveyed of 4,500 square miles. Two weeks were also spent in Pike County, during which most of the mines were visited and much information obtained which will not be available in the Spring when the survey of the county will be completed.

In that portion of the area which has been finished every mine has been visited, and, as far as time would allow, every known outcrop,

in order to obtain records of all the prospect bores, well sections, etc., possible, and especially to make a systematic topographic survey from point to point along the outcrop of the principal coal beds. The information sought has been for two purposes; first:

General, to obtain the salient topographic features of each part of the area; to obtain typical columnar sections, especially with regard to the coal, with the variations from place to place; to obtain the characteristic features of each principal coal bed, as regards stratigraphic details and thickness, quality, quality of roof, of under-clay, workability, adaptability for different purposes, etc.; to obtain the distribution of each workable coal bed, both vertically and horizontally, etc., etc.

Secondly, from the data thus obtained, combined with the data obtainable at any point, to be able to tell at that point what coals underlie that region, their depth below drainage, thickness and details concerning quality, accompanying strata, characteristics by which each bed may be recognized, probable condition of roof and under-clay and other factors affecting workability.

There yet remain to be surveyed, Gibson, Pike (in part), Dubois, Warrick, Vanderburgh and Spencer counties, and parts of Posey, Orange, Crawford and Perry counties. It is planned to push the work on these counties the coming year with the hope of completing them fairly early in the season so as to allow the completion of the report as a whole by November 1st, 1898.

In the report the following subjects will be treated:

- I. General geology of Coal.
- II. General geology of Indiana coal field.
- III. Mining methods, etc.
- IV. Details of coal distribution in Indiana.
- V. Summary of coal and mining. (Tables and statistics.)

In addition, there are contemplated 7 colored geological maps on the scale of two miles to the inch; page or double page maps on the scale of one mile to the inch of all the more important coal areas; drawings illustrating typical columnar sections, detailed coal sections, cross sections, besides numerous figures illustrating geological features of the coal, and mining methods, together with some half-tone plates, showing mines, processes, etc. In preparing the report it is planned to group similar matter as far as possible, making comparisons easy and revealing relations and facts that otherwise would not be observed.

In the matter of progress, it may be stated that four of the colored maps are nearing completion; 12 double-page and 16 single-page

maps are completed or in progress; nearly 30 cross sections have been prepared; also between 75 and 100 columnar sections, near 300 coal sections, and about 50 figures, from page size down, of mining and geological subjects. Part I. of the report is ready for the press. Parts II. and III. are well under way, and 300 pages of Part IV. are finished.

When this report on Indiana coal is completed, any one wishing to know the area, average thickness or quality of the coal belonging to any one of the seven workable veins of the State can have access to a work which will furnish him the information desired.

MINE INSPECTOR'S REPORT.—The report of the State Mine Inspector, Mr. Robert Fisher, will be found, in the present volume. It shows that the output of coal in Indiana in 1897 was 4,228,085 tons, or 159,961 tons more than in 1896. When it is remembered that an extended strike among the miners began July 4th and continued until September 14th, the output for the year is a very creditable one.

In those mines of the State operating ten or more men, 7,636 miners are employed. In the smaller mines nearly 900 additional men are at work, making a total of 8,500 miners in the State. The report shows also a large decrease in 1897, in the number of accidents in the mines, there being but 16 fatal, 24 serious and 74 minor accidents, as against 28 fatal, 66 serious and 94 minor in 1896. Such a decrease is excellent proof of the efficiency of the work done by the Mine Inspector, and his deputy, Mr. James Epperson, in seeing to it that many of the former elements of danger about the mines have been removed or modified.

While the State Inspector and his assistant visit many of the mines employing less than ten men, and make recommendations, the law gives them no power to enforce better conditions of ventilation and measures of protection. A bill was introduced into the last Legislature giving them such power, but it failed of passage. Such a statute is one of the most needed additions to the mining laws of the State, since the life of a miner working in a small mine is just as valuable as that of a man working in any of the larger ones.

The report of Mr. Fisher will be found to contain much statistical and other information differing in nature from that compiled for former reports, and to it the reader is referred for additional details concerning the mining industry of the State.

PETROLEUM.—For the first time since the discovery of petroleum in Indiana, the annual production has fallen below that of the preceding year, the total production for 1897 being 4,353,138* barrels, as against 4,680,732 in 1896—or a decrease of 327,594 barrels. The

* This does not include the amount used for fuel and other purposes in the field.

prevailing low price of Indiana petroleum, which averaged for the year but 43 cents per barrel, or 20 cents less than in 1896, prevented the sinking of many new bores in the main petroleum field, and the old wells in that field decreased on an average about 40 per cent. in output.

New developments of importance were made near Alexandria, Madison County; Peru, Miami County, and Broad Ripple, Marion County. The Alexandria field very probably has an unbroken connection with the main field to the northeast, and tends to prove the belief advanced in both of my former reports that the entire gas field of the State will, in the near future, yield petroleum in greater or less quantities. The Peru and Broad Ripple productions are more probably from isolated areas of porous Trenton limestone. Such areas are very liable to be found on the slope of the main gas field anywhere within 15 to 25 miles of its margin. A paper, giving in detail the developments made in the new fields during the past year, and accompanied by maps of the Peru and Broad Ripple fields, will be found in the present volume.

The petroleum produced in Indiana is piped and shipped from the productive areas by three companies. The largest of these, the Indiana Pipe Line Company, with headquarters at Lima, Ohio, handles more than three-fourths of the production, and kindly furnished me with statistics showing the amount handled by them each month. The other two companies—The Indiana Pipe Line and Refining Company, controlled by the Cudahy Bros., of Chicago, and the Manhattan Oil Company, of Lima, Ohio, refused to furnish statistics showing the number of barrels handled. Since petroleum is one of the more important mineral resources of Indiana, and since accurate statistics relative to the State's production are of value in showing the mineral wealth of our State, and thereby attracting capital and population within her bounds, I would advise the passage of a law by the next General Assembly, compelling all companies or individuals shipping or piping crude petroleum from the receiving tanks at the wells, to furnish to the Department of Geology monthly statements showing the number of producing wells and the number of barrels so piped or shipped. Such monthly statements must, according to law, be furnished the Department by all operators of coal mines, and there is no reason why the oil companies should not be compelled to do likewise.

The total amount of oil produced in Indiana since 1889, when the first wells were sunk, has been 20,386,231 barrels,* valued at \$10,816,-

* Not including the amount used for fuel and other purposes in the field.

326. The real value of a barrel of crude petroleum is much greater than 43 cents, the average market price in 1897. When the market price rises more nearly to the true value there is little doubt but that the industry will take new life, and bores sufficient in number will be sunk to bring the production up to or above that of 1896. The oil has been stored for thousands of years in the porous reservoirs, from which it is now being obtained, and the operators are content to let it remain there as long as prices are kept at a figure which gives but little profit above the actual cost of production. Unlike the gas, there is little danger of its dissipation and loss during the wait for a rise in the price.

REPORT OF THE STATE SUPERVISOR OF NATURAL GAS.—No unbiased person can read carefully the report of Mr. J. C. Leach, State Supervisor of Natural Gas, printed in this volume, and not conclude that we are nearing the end of the supply of this valuable fuel in Indiana. This report but affirms what has been written in the previous reports of this Department, even as far back as 1890.

The natural gas field of the State originally embraced almost 3,000 square miles. To-day the productive area is less than half that size. The average rock pressure was in the beginning 325 pounds; to-day it is less than 200 pounds. Mr. Leach reports that in the heart of the field, an area of 250 square miles, located in Grant, Madison, Blackford and Delaware counties, the pressure decreased 30 pounds in 1897, and now averages but 215 pounds; while in these four counties, which are the most productive of the entire field, the average pressure is but 200 pounds. This decrease in rock pressure, added to that of an exhaustion of one-half of the original productive area and the constant encroachment of salt water towards the center of the field, all point to the final exhaustion of the supply.

In the face of these facts there are many men in the gas field who are either so foolish, so woefully ignorant, or so dishonest as to decry constantly the idea that the supply of natural gas is failing. They assert, in spite of the evidence of the best scientists in America to the contrary, that the gas is being generated as fast as it is used. They continue to attempt to boom, on every occasion, the gas field. They still offer "free gas and free lands" to all factories that will locate near their towns. They condemn the reports issued by this Department. They have even told the Supervisor that the truth ought not be told; that it was not necessary to proclaim to the world the fact that gas is failing.

Such men evidently forget that this Department was organized to advertise the resources of Indiana as they are, not as boomers would

have them. If the supply of a resource is failing, or if its quality is defective, it is as much the duty of this Department to make known such facts as it is to publish an account of those resources which are increasing in quantity or possess some newly discovered excellence of quality. The vast majority of the people of the State expect the truth in the reports of this Department, and the truth must be told as nearly as it can be ascertained by careful investigation.

The chief duty of the State Supervisor of Natural Gas is to prevent, wherever possible, the waste of the fuel. This duty Mr. Leach has performed to the best of his ability with the means at his command. As an assistant in this Department, he was directed to enforce the flambeau law, and by his efforts the burning of such lights has been practically abandoned. When the waste of gas began last May in the vicinity of Alexandria, I directed him to use the full limit of his powers to stop such waste, and he immediately began the enforcement of such laws as were on the statute books. He was condemned by many for not stopping the waste at once, and additional directions were given him by the Chief Executive of the State, but it was soon found that he was already doing all that he could under the existing laws, which are defective in that they do not give the Supervisor the power to cap any well whose owner insists on allowing the escape of gas. At first his efforts were condemned by many of the citizens of Alexandria, who saw a prospective oil boom in their midst. However, the rapid decrease of the rock pressure, consequent upon the wanton waste of the gas, soon brought those citizens to a proper realization of their best interests, and led them to add their efforts to those of the Supervisor in trying to stop the waste. As a result, several cases have been pushed, and are now before the Supreme Court of the State, which will soon decide whether a party in search of a few hundred barrels of oil can jeopardize the interests of thousands of citizens by allowing a waste which will soon deprive those citizens of a most valuable necessity.

The manufacturers of the gas field have, for the most part, done all that they could to stop the waste. Their association has advanced means and furnished help to assist in shutting off all unnecessary flow of gas. They realize that the future life of the field, as compared with the past, is of short duration, and they desire to prolong it as much as possible.

No one can say with certainty how long the supply of gas for manufacturing purposes will last in Indiana. It may be for one year; it may be for five. When it fails, the factories now in the field will not of necessity have to move therefrom. Petroleum can and will be

used as a fuel in many of the factories. Improved methods of separating the gas from coal are constantly coming to the front, and the time may come when artificial gas from this fuel will be made in quantity and piped to the factories in the gas field. Again, their situation within 70 miles of the center of a great coal basin will give them advantages which, though far inferior to those they now possess, will still enable them to compete with many of the factories of the East, where fuel has to be transported a much greater distance.

Every one will admit that the highest use to which this gaseous fuel can be put is that of household consumption. With no kindling, no replenishing, no ashes, no soot, the duties of the housewife are decreased many fold. For this reason every effort should be made to husband the present supply by stopping at once all unnecessary use or wanton waste. Any attempt to evade the law relative to the waste of gas should be promptly reported to the proper officers. Instances were cited during the past season of persons who piped the gas into a pile of brick and burned it, hoping thereby to keep themselves within the pale of the law. All such persons are wholly lacking in public spirit, and devoid of every feeling which tends to advance the interests of humanity. All future attempts to locate large factories within the field by promising them free gas should be decried. Such factories can but shorten the present fuel supply of those in existence, and diminish the amount which will in the future be available for household purposes.

THE GEOLOGY OF LAKE AND PORTER COUNTIES.—In the law creating the Department of Geology it was specified that one of the duties of the State Geologist shall be the continuation "of the geological survey of the State by counties or districts, and the completion and revision of the same as may be practicable." My predecessors in charge of the Department followed this law literally, and in the annual reports previous to the Twentieth, dealt with all the counties except Adams, Blackford, Fulton, Hendricks, Kosciusko, Lake, Porter, Tipton and Wells. All of these counties are included in the drift-covered area of the State, and but few outcrops of rock are found within their bounds.

Since the civil boundaries of a county have little or nothing to do with the limits or boundaries of a natural resource or geological formation, the work of the Department for the past three years has, in the main, been devoted to the preparation of monographs on each of the leading natural resources of the State. The worthy citizens of Lake and Porter counties, occupying, as they do, that region of the State lying nearest the great city of Chicago, have felt that the De-

partment of Geology had not done them justice in the bestowal of its favors in the past. It was thought best, therefore, to continue, for a time, the work based on the county boundary system, and several months of the summer and autumn of 1897 were spent by the writer in gathering data for a paper entitled "The Geology of Lake and Porter Counties, Indiana," which appears as a part of the present volume.

The paper is, in the main, devoted to the physiography or surface features of the two counties, since not a single outcrop of rock is located within their bounds. Lying, as they do, adjacent to the southern shore of Lake Michigan, much of their northern portion is covered with sand. Unfortunately, the more important railways which pass through the counties traverse this sandy region, and the traveler bears away with him wrong ideas concerning their fertility and general prosperity.

No one who spends a considerable period in the study of the surface of these two counties can deny that a large percentage of their area ranks among the most fertile lands of the State. In the production of hay, Lake stands second and Porter third among the 92 counties of Indiana; while in the production of milk, Lake ranks third and Porter fifth. Much of the sand-covered area is admirably adapted to the raising of small fruits and vegetables; and the thousands of acres of marsh-land in the valley of the Kankakee is being rapidly drained, and in time that section will be known as the garden spot of northwestern Indiana.

While no ledges of stratified rock were available for study, interesting problems were presented relative to the glacial deposits, the formation of sand dunes and prairies, the former extent southward of Lake Michigan, etc., and a discussion of these and many other features is given in the paper which follows. It is also accompanied by a map showing the more salient physiographic features of the area under consideration.

THE CLAYS AND CLAY INDUSTRIES OF NORTHWESTERN INDIANA.— Since the publication of the paper on the "Clays of the Coal-Bearing Counties of Indiana," in the report of this Department for 1895, the interest in Indiana clays and their possibilities for manufacturing purposes has largely increased. Scarcely a day passes but that inquiry by letter or person is made at the office of the Department concerning the clay resources of the State. Large factories have been recently erected near Mecca and Montezuma, Parke County; Brazil, Clay County, and Martinsville, Morgan County, for

the purpose of utilizing the deposits described in detail in the report cited, and additional factories will be erected in 1898 west of Terre Haute and north of Brazil.

After the completion of the work in Lake and Porter counties, all the available time of the writer for the remainder of the season of 1897 was spent in an examination of the clays and clay factories of eight of the northwestern counties of the State, and the results of that examination are incorporated in a paper entitled "The Clays and Clay Industries of Northwestern Indiana," which is published in the present volume.

While no material suitable for the best grades of vitrified ware or pottery was discovered in the area visited, much which could be utilized in the making of pressed front brick, hollow brick, terra cotta lumber, and many fire-proof products was found. The largest pressed-brick factory in the State is located at Porter, Porter County, while at Hobart, Lake County, another, of almost equal capacity, is in course of construction. One factory at Hobart has been making terra cotta lumber for ten years, and the owner claimed to have the only deposit of clay in the State suitable for such material. The investigations and chemical analyses made and given in the paper cited prove the presence of a similar clay in a number of other localities in Lake, Porter, Laporte and St. Joseph counties. Capital invested in the making of porous fire-proof products at any or all of the points mentioned will, without doubt, return handsome revenues, since such products are coming into rapid use in the larger structures of all the leading cities of the United States.

The Knobstone shales which come to the surface over a large area in Jackson, Morgan and adjoining counties north and south, have, as yet, been practically unutilized for manufacturing purposes. In July, 1897, a careful study was made of a number of deposits of these shales in Jackson County, and an exhaustive chemical analysis shows their especial adaptation to the making of vitrified brick and sewer pipe. A plant erected by the side of the B. & O. S. W. Railway six miles west of Seymour can hardly fail in furnishing southeastern Indiana with the best grade of such products for a score of years to come.

The practical experience of the past ten years has proven that no more durable material for the making of pavements can be used than vitrified brick, provided sufficient care be taken in the structure of the foundation upon which the brick are placed. Such a pavement comes nearer than any other to a typically perfect pavement; i. e., one which is reasonable in first cost; low in cost of maintenance and easy to repair; durable under heavy traffic, with reasonable freedom from noise.

and dust; free from decay, water proof and non-absorptive; of low tractive resistance and furnishing a good foothold for horses.

The city of Chicago has recently let the contract for 66 miles of vitrified brick pavements, and a number of miles of brick roadway were constructed in 1897 in the country near Monmouth, Illinois. The making of paving brick is an industry yet in its infancy in Indiana, for the time will come, and that before many years, when not only the streets of every town of two thousand inhabitants within our State will be paved with brick, but also many of our country roadways in those regions devoid of gravel and other road material.

UTILIZATION OF CONVICT LABOR IN MAKING ROAD MATERIAL —
The question of good roads is at present one of the most vital with which the farming community of Indiana has to deal. Many of the better counties of the State long ago realized the importance of this question, and, where road material was conveniently located, constructed gravel or macadam roads radiating in all directions from their county towns. In other counties, possessing a plentiful supply of road material, the importance of the question has not yet been realized, and for six months of the year the farmers are practically isolated from market, or, if they manage to reach it once a week, can only haul thereto a fraction of a load. Such counties are readily recognized as far below the average in wealth, prosperity, and the public spirit of their citizens.

Prof. Latta, of Purdue University, has for some time been making a careful study of the good roads question in the State, and has received reports from hundreds of farmers, some of whom live on good roads once bad, and others on roads still bad. From these reports he has computed statistics showing that the difference between good and bad roads amounts to 78 cents an acre annually on the farms. Applying this amount to the entire State—36,350 square miles, or 23,264,000 acres—we have the sum of \$18,145,920. Of this amount, fully two-thirds is wasted every year in the State in the loss of time, and in the loss of opportunity in securing the best market for the produce of the farm.

Moreover, our vehicles for rapid country travel are more numerous and of an entirely different style from what they were twenty years ago. Almost every farmer now owns his own buggy and carriage. The bicycle by countless thousands has come to stay, and the horseless carriage and motorcycle will ere long make their appearance upon the scene. The owners of all these lighter forms of vehicles are demanding, and will continue to demand, better roads, and the legislator must soon learn that the question is one of the most important which he has to face.

Through all the panic and depression of the last four years, the farmers in the good road districts of Indiana, have gone on making money and improving their farms, and have not troubled themselves to any extent about politics or finance. On the other hand, those living in the bad road districts have, for more than a third of their time, endured an enforced idleness which has made them poorer, and caused them to cry out against the financial policy of the government, rather than against their own short-sightedness on the road question. Indiana is rich in clay suitable for vitrified brick, rich in gravel, rich in stone for macadam roads. There is no reason, therefore, why every public road of any importance in the State should not be improved so that it can be traveled with ease any day in the year.

In the penitentiary at Michigan City there are to-day almost a thousand able-bodied men who are being marched about to furnish them exercise, because the labor organizations of our State are opposed to their competition. The industry of the honest citizens of the State pays for maintaining these criminals in idleness. Let the General Assembly authorize the purchase of an extensive bed of shale in western Indiana; and the erection on it of a modern paving brick factory. Equip this factory with convict labor, and put several hundred additional convicts to breaking stone for foundation, and cutting it for curbing. This brick and stone can then be furnished at the plant at less than one-sixth present prices to those counties devoid of other road material.

The cost of a paving-brick plant, completed for work, which has a capacity of forty thousand output per day, is about forty thousand dollars. One with double the capacity costs about \$60,000. The greater amount of this expense is for buildings and kilns which could, by convict labor, be constructed of brick made on the spot, so that the cost to the State would be less than half this sum. After the plant is once in operation, with fuel and raw material both at hand, the only outlay is for labor. Where the daily output is eighty thousand brick, and the fuel is mined in connection with the shale, the number of hands necessary is about 125. These, at \$1.50 each per day, would make the cost of the brick about \$2.35 per thousand. With convict labor, the actual cost of the brick would be only the sum paid out for the maintenance of the prisoners. At 50 cents per capita, this would amount to about 80 cents per thousand. With a plant erected which will give employment to 375 men, 240,000 brick can be made daily. A year's output will be sufficient to pave almost one hundred miles of roadway.

The paving brick can be sold to the counties constructing the roads at \$1.00 per thousand, which would require an outlay of but \$760

per mile. The crushed stone prepared by convict labor can be furnished at 30 cents per cubic yard, and the curbing at a correspondingly low price. A road of vitrified brick, which will last a quarter of a century or longer with little expense for maintenance, can then be built and need cost but little if any over \$2,500 a mile, the most of which would be for grading and the laying of the brick. For, understand, the plan proposed does not consider that the convicts be employed except in the preparation of the material, the latter to be furnished at cost to the counties. All grading, teaming, bricklaying, etc., should be done by free labor, as it is at present. The day of the chain gang at work on the roadside, subjected to the gaze and jeers of the passer-by, is, rightfully, a thing of the past.

Five years ago California was in the same situation as Indiana is to-day. Her convicts were idle in deference to the wishes of her labor organizations. Her legislators passed a law authorizing the employment of the convicts in the breaking of stone for road material. To-day that State is supplying the prepared stone to the counties at 28 cents a cubic yard, on board the cars, which is less than one-third the ordinary market price; yet sufficient to pay for the maintenance of the convicts. The railroads of the State are carrying the material at the bare cost of hauling, for they realize that the improved country roads will bring to them in the future a great increase in farm products for shipment.

Many objections to the plan proposed will doubtless arise, for the questions to be solved are important ones, and for that reason no plan can or will be presented but what will have its weak points. The most serious of these objections is the cost of a new prison which would necessarily have to be constructed at the plant. This, however, would be much less than is generally supposed, since the shale can be burned into ordinary and pressed front brick of the finest quality. The brick could, therefore, be made and the prison constructed by the convicts themselves for a very reasonable cost. Moreover, fine building and pressed front brick could be made and furnished the other institutions of the State, at cost, whenever needed, thus reducing materially the amounts necessary to be appropriated from the public funds for new buildings and repairs. It seems, therefore, that given an ever-growing demand for better roads; an abundance of nature's products which can be made into the best of road material, and 850 convicts able and willing to work, that we have a combination which, under the proper management, would give us the improved roads, furnish employment for our convict labor,

and yet give no offense to that army of honest workingmen whose interests and welfare are ever to be upheld.

REPORT ON THE NIAGARA LIMESTONE QUARRIES.—The Niagara limestones of southeastern Indiana have, for a number of years, been extensively quarried, especially in Decatur, Franklin and Fayette counties. As yet, however, no detailed report upon the properties and uses of the stone, or the leading features of the deposits has been published. During the past season, Dr. August Foerste was engaged in collecting information for such a report, which he has prepared for the present volume.

The most valuable variety of the Niagara stone quarried is typically exposed in the vicinity of Laurel, Franklin County, and so to all stone of that variety the name "Laurel limestone" has been applied by Dr. Foerste.

This stone can be quarried more easily and at less expense than any other stone of a similar nature in the State; the natural seams and even bedding doing away largely with the necessity for drilling and blasting. The stone occurs in natural slabs of a uniform thickness—two to twenty inches—and with the upper and lower surfaces very even, so that for many purposes tool dressing after quarrying is not necessary. It is of a handsome color, very hard and durable, and is used extensively for flagging and curbing, and to a less extent for window sills, window caps, range stone, ashlar, door-steps, foundations, street crossings, gutter stone, pier footings, bridge abutments, etc. For many of these uses it is better suited, and can be furnished more cheaply, than either the Bedford oölitic limestone or the Berea (Ohio) sandstone, the two materials with which it comes in closest competition. The railway facilities of the region about Laurel and other localities, where the best deposits are found, are, as yet, very poor, the stone from most of the quarries being hauled on wagons to the cars. With several good switches to the leading deposits, this stone could be put on the market for a lower price, and yet with a greater profit, than is now secured; and its superior quality would soon lead to its extensive adoption for those purposes for which it is so well fitted.

CATALOGUE OF THE FOSSILS OF INDIANA.—The subject of paleontology has, during the past three years, received but little attention in the reports of this Department. That subject had been quite fully treated by my predecessors, and the economic resources of the State, which have been constantly growing in importance, demanded the time and energies of the force at my command. That the paleontology of the State be wholly neglected was not intentional, however, and Mr. E. M. Kindle has, therefore, prepared for the present volume

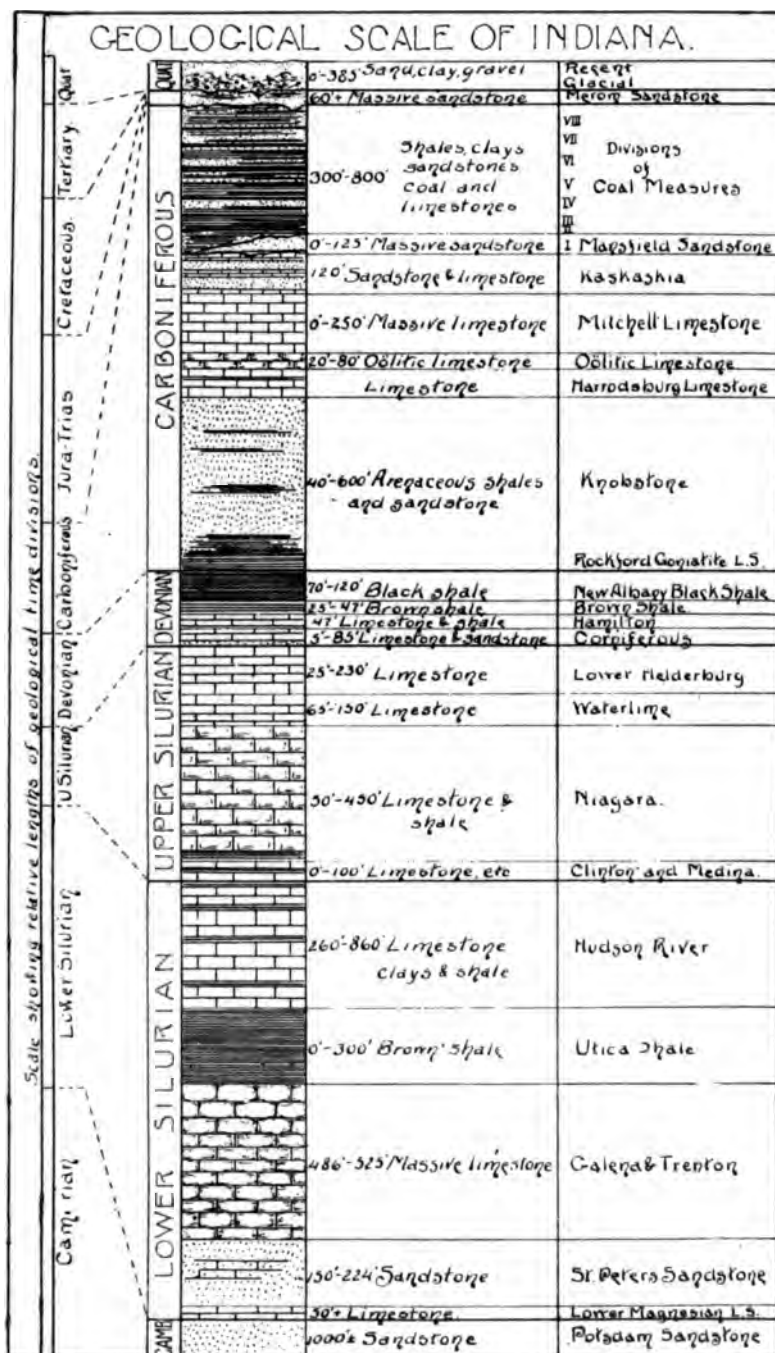
a list of all the fossils known to occur in the State. This list shows also the geological formation in which each species is found, and is accompanied by a bibliography of Indiana paleontology, making a paper which will doubtless be of much value to all collectors and students of the remnants of that rich fauna and flora which once existed in or near the waters in which the rocks of our State were laid down.

THE BIRDS OF INDIANA.—Students of Natural History throughout the State have long felt the need of a descriptive work on the birds of Indiana, which would enable them to readily recognize any species which might come into their hands. Such a work, I am pleased to say, has been prepared for the present volume by Mr. A. W. Butler, formerly of Brookville, Indiana, now Secretary of the Board of State Charities. Mr. Butler has devoted many years to the study of Indiana birds, and no man in the State knows more of their habits and distribution than he. For twenty-two years he has been gathering the data for such a report, and for that reason it can be relied upon as accurate and comprehensive.

In the paper will be found a description of each of the 321 species of birds which have been identified within the bounds of Indiana in the past; together with a description of the nest and eggs, and a statement of the geographical range of each species. An artificial key to the species is also given which will enable any one, after a little practice, to bring about their ready identification.

An account of the food habits and song of each species is also added, together with a statement of its abundance or scarcity, the season of the year in which it occurs within the State, and the time of its arrival therein and departure therefrom. A bibliography of the literature pertaining to Indiana birds and a list of those species which, by reason of their reported occurrence in adjacent States, may also occur within Indiana, is also given.

The work has been prepared with as few technical terms as possible in order that it may be readily used by boys and girls of the farm who come daily in direct contact with the birds, and by the pupils of our schools, who should have a more general knowledge of the names, songs and beneficial habits of our feathered friends throughout the State.



GEOLOGICAL SCALE OF INDIANA.

BY W. S. BLATCHLEY AND GEO. H. ASHLEY.

At my suggestion, Mr. Geo. H. Ashley has prepared for the present volume the accompanying table* (Plate II.), showing a columnar section of all the rocks of the State, the time period during which each group was laid down, a statement of the character of the dominating rocks of each group, and in the last column the names given to the more important subdivisions.

THE POTSDAM SANDSTONE.—In most instances in which bores for gas or oil have pierced the full thickness of the Trenton limestone, the underlying sandstone has been recorded as Potsdam sandstone. It is probable, however, that Potsdam sandstone has been reached only in the deep wells at Hammond, Crown Point and La-Porte at a depth of about 600 feet below the bottom of the Trenton. At Crown Point it was pierced about 1,000 feet without reaching its base. It does not outcrop in the State.

THE LOWER MAGNESIAN LIMESTONE.—According to Phinney, (loc. cit. p. 625) this stratum is represented by the last 50 feet pierced by the drill at Bloomington, and probably also by the boring at Greenwood, Johnson County. It is a grayish, sandy limestone, and outcrops near Utica, Illinois, but nowhere in this State.

THE ST. PETER'S SANDSTONE.—This formation has been penetrated by a number of bores which have passed through the Trenton limestone, and has usually been recorded as Potsdam sandstone. It varies from a pure sandstone to a sandy limestone, and is usually of a light color. It outcrops near Utica, Oregon and Polo, Illinois, and also in Wisconsin, but not in Indiana. It is a very porous rock, well

*In the preparation of this table and text Mr. Ashley and myself have drawn largely on the details given by Mr. A. J. Phinney in his paper on the "Natural Gas Field of Indiana," published in the Eleventh Annual Report of the U. S. Geol. Survey; and also upon the recent papers of Messrs. Hopkins, Siebenthal and Kindle in the last two reports of this Department; while upon Mr. Ashley's work in the field is based that portion of the table pertaining to the coal measures and overlying beds.

adapted for transmitting water, and is a common source of much of the water in many of the deep artesian wells of northern Illinois and Indiana.

THE TRENTON AND GALENA LIMESTONES.—This formation has become popularly known as the reservoir of most of the natural gas and oil found in the State. It is a massive stratum of limestone with a very little shale in places. Where containing gas and oil it is dolomitic in nature, and much more porous than where devoid of those bitumens. It probably underlies the entire State, with an average thickness of about 500 feet. It does not outcrop within the State, and its known closest proximity to the surface is near Lawrenceburg, where it is 348 feet below.

The upper and later portions of the Trenton are lead-bearing in Illinois and other States, and to them the name Galena limestone has been applied. These portions are darker than the typical oil-bearing Trenton, and have been struck in a number of the deep wells in northern Indiana.

THE UTICA SHALE.—This formation is a persistent, fine grained, dark brown or black shale, which immediately overlies the Trenton and forms the necessary impervious cover above the oil and gas-bearing portions of that limestone. In the eastern half of the State the Utica has a recorded thickness of nearly 400 feet, but grows thinner to the northwest, and seems to be wholly absent in the bores in Lake and Porter counties. It does not outcrop in Indiana, but probably underlies the greater portion of the State.

THE HUDSON RIVER LIMESTONES AND SHALES.—These are the oldest rocks which come to the surface in Indiana. They outcrop only in the southeastern corner of the State; forming the surface rocks over all or a portion of the counties of Switzerland, Ohio, Dearborn, Franklin, Union, Wayne, Fayette and Ripley. In several of the adjoining counties to the west they are also exposed in the ravines and deep cuts. This formation consists of bluish-green shale, bluish limestone and clays; the limestone being most prominent in the upper part of the series. The greatest recorded thickness of the formation is 860 feet. It thins to the northwest, being represented in the bores at Crown Point by only 122 feet of bluish-green shale. The upper part of the series is very fossiliferous, and has been long and extensively studied.

THE CLINTON LIMESTONES.—This formation, which is represented by thick deposits in some of the Eastern States, is known in Indiana only as a thin stratum of salmon brown or reddish, rather

coarse-grained limestone. It outcrops over small areas in several counties of the southeastern corner of the State,* and has been pierced by a number of bores in the northern portions.

THE NIAGARA LIMESTONE.—In the stratigraphy of Indiana, this subdivision comprises the greater portion of the Upper Silurian period, forming the surface rocks in a number of counties in the eastern and northern portions of the State. The base of the formation consists of a characteristic bed of bluish-green shale ranging in thickness from 2 to 40 feet. Overlying this is a heavy stratum of limestone varying from 100 feet in thickness along the Ohio River to 440 feet in the northern and northwestern portions of the State. This limestone ranges from a sub-crystalline buff, through a bluish crypto-crystalline to a bluish-green shaly limestone. In Decatur, Franklin and Wabash counties, it is largely quarried for flagging, curbing and similar uses; and near Huntington and Delphi it is used extensively for lime.

THE WATERLIME AND LOWER HELDERBURG.—These are closely related limestones, whose known thickness in the State varies from 15 to 150 feet, and 25 to 250 feet, respectively. The Lower Helderburg is a buff to gray cherty limestone, which, when exposed by erosion, is often irregular and uneven in its bedding. It outcrops along the Wabash River near Logansport and farther northwest near Monon and Rensselaer. The Waterlime is chiefly represented in northern Indiana, outcropping near Kokomo, where it is extensively quarried for building material, and also near Logansport. Farther north it so merges into the Lower Helderburg that the two are difficult to distinguish.

THE CORNIFEROUS.—This formation is represented in Indiana by sandstones 15 to 20 feet thick, thought to correlate with the Schoharie group of New York, and by limestones 5 to 65 feet thick, correlated with the Upper Helderburg. The petroleum at Terre Haute probably has its origin in the limestone of this subdivision.

THE HAMILTON.—Dr. Phinney ascribes to this group a 20-foot stratum of brown calcareous shale and an overlying bed of dark gray limestone, 27 feet in thickness, which were penetrated by a bore at Goshen. The formation has not yet been recognized in southern Indiana.

THE NEW ALBANY OR GENESEE SHALE.—This shale, and a persistent underlying brown shale, forms the top of the Devonian system in Indiana, and has been recognized in all the deep bores

*See paper by August Foerste, 21st Rep. Ind. Geol. Surv., 226; also paper by same author in this volume.

drilled west of its eastern outcrop. This outcrop extends from the Ohio near New Albany in a northeasterly direction through Floyd, Clark, Scott, Jefferson and Jennings counties, then northwestwardly through Bartholomew, Johnson, Marion, Boone, Clinton, Carroll and White counties. The shale forms the surface rock of an area eight to fifteen miles wide in these counties or those adjacent on the west. It is also known to be the formation immediately underlying the drift over quite a large area of the two northern tiers of counties in the State.

This shale is rich in bitumens, and when kindled will burn until they are consumed. These bitumens are, by natural processes, often separated from the shale, and in the form of gas or petroleum, are collected in reservoirs in it or underlying strata. Such reservoirs form the source of the gas and oil hitherto developed in Washington, Harrison and Pike counties. As a rule the quantity so collected is not large and the supply is, therefore, soon exhausted.

THE KNOBSTONE.—Overlying the Rockford Goniatite Limestone, which is a thin bed of limestone and calcareous shale forming the base of the Subcarboniferous, is the Knobstone. This formation consists of a series of alternating shales and sandstones, which, in places, reach a thickness of 600 feet. It can probably be correlated with the Waverly group of Ohio and Michigan. The Knobstone comes to the surface in a strip five to forty miles in width, extending over a portion or all of Clark, Washington, Jackson, Brown, Morgan, Hendricks, Boone and Montgomery counties. In some places the shales of this horizon will be found to be excellently adapted to the making of vitrified wares, as paving brick, sewer pipe, etc., though, as yet, their possibilities of service in this way have been ignored.

THE HARRODSBURGH LIMESTONE.—This subdivision, sometimes called the Keokuk, consists of limestones and shales with a total thickness of 60 to 90 feet. It forms the surface of a belt four or five miles in width between the Knobstone and the oölitic limestone. Where found it is accompanied by great numbers of geodes or "mutton heads."

THE OÖLITIC LIMESTONE.—This subdivision is the source of the "Bedford Oölitic limestone," so widely and favorably known as a building and ornamental material. The stone is a calcareous sandstone or freestone, differing from other sandstones in having the grains composed of practically pure carbonate of lime instead of quartz: and from other limestones in its granular texture and freestone grain. It usually appears as a massive bed, varying in thickness

from 25 to 100 feet, and in color from buff to blue. It comes close to the surface in a belt two to fourteen miles in width, which extends from Greencastle, Putnam County, to the Ohio River, through Owen, Monroe, Lawrence, Washington, Perry and Crawford counties.

THE MITCHELL LIMESTONE.—The name was applied by Messrs. Hopkins and Siebenthal to the series of impure limestones and calcareous shales, aggregating nearly 250 feet in thickness, which overlies the oölitic limestone. It is in this formation that the many sink-hole and caves of southern Indiana occur. Lithographic stone of good quality has also been found to be a member of the series, but as yet has not been discovered in commercial quantities.

THE CHESTER OR KASKASKIA.—This group, recognized by E. M. Kindle, occurs in the counties bordering the coal measures on the east from Putnam County southward. It consists of three limestones separated from each other by sandstones,* the total thickness of the series being about 120 feet. It contains some stone suitable for building purposes.

THE MANSFIELD SANDSTONE.—This, the basal member of the coal measures, corresponds to the "Millstone Grit" of adjoining States. It consists of a medium to coarse-grained massive sandstone, associated with isolated deposits of conglomerate shaly sandstone, shale, coal and fire clay, the whole approximating 125 feet in thickness. It forms the surface rock over a strip of two to twelve miles in width, extending from the north part of Warren County in an east-of-south direction to the Ohio River, a distance of 175 miles. In a number of localities, notably at Attica, Williamsport and St. Anthony, the sandstone is quarried; while at Portland Mills and Mansfield, Parke County, and near Bloomfield, Greene County, are excellent deposits of a brown variety of the stone which is especially adapted for a finishing material for buildings whose fronts are composed of pressed brick. The whetstone and grindstone rocks of Orange and Martin counties are also members of this group. The kaolin of Lawrence and Martin counties also occurs near the base of this division.

THE COAL MEASURES.—The coal measures, including the Mansfield sandstone, occupy all of fifteen counties from Vermillion and Parke southward, and most or part of 11 additional counties extending from Benton southeast to Perry County. The rocks consist of shales, sandstones, clays, coal and limestone. Of these, the first greatly predominates. In thickness the coal measures vary from 300 to 800 feet. Measurements across the outcrop show an average of about 400 feet, but a number of deep drillings in Daviess and Knox counties indicate

* See 20th Rep. Ind. Dep. Geol. and Nat. Res., 1896, 331.

that the lower part of the measures have been overlapped, and increase the thickness in that region to 800 feet.

The shales of the coal measures are in many places very suitable for the manufacture of paving brick, sewer pipe and allied products, and with the clays underlying the coals, are being extensively developed. The coal occurs in basins ranging from a part of an acre up to hundreds of square miles, the coal veins and accompanying strata increasing in persistency and in size of coal basins from the bottom to the top. About 30 horizons have been noted at which coal is found, though only a few of these show coal persistently. The most of the coal is obtained from five horizons, though locally, coal of good, workable thickness occurs at, at least, five other horizons. Most of the coal is of the caking bituminous variety, though much of that occurring in small basins near the bottom of the measures is either non-caking or splint (the so-called "block coal"), or semi-caking. Good cannel coal occurs locally. In thickness the beds vary up to 10 feet, the "block coal" having an average in the mines of 3 feet 1 inch, the caking coals where extensively mined, will probably average four and one-half or five feet. The "semi-block" coals will average between the others. The total thickness of coal at any given point will range up to 32 feet, but over much of the field will range between 10 and 15 feet, not more than one-third or one-half of which is workable under present trade conditions.

The coal measure sandstones, though often of considerable thickness, are seldom of desirable quality, though locally very desirable stone is found. The limestones, though thin, are usually quite persistent. Some gas has been obtained from the bituminous shales which often accompany the coal.

THE MEROM SANDSTONE.—This is a massive, coarse-grained sandstone, some 60 to 200 feet thick, lying unconformably on the coal measures. Its age is in doubt, being probably either Permian or Triassic. With some doubt the sandstone filling deep and broad erosion channels in the north part of the coal area has been thought to correlate with the Merom sandstone of Sullivan County. In that case this sandstone furnishes the glass sand of Coxville, the building sandstone of Silver Island, Fountain County, and elsewhere.

TRIASSIC TO TERTIARY, INCLUSIVE.—The only deposits of these ages known (with the possible exception of the Merom sandstone as noted) are some gravels found on certain high ridges in Martin and Perry* counties, and possibly elsewhere. These are outside of the drift area, and above any known stream deposits of

* See Cox, E. T.—Geol. Surv. Ind., 1872, 138.

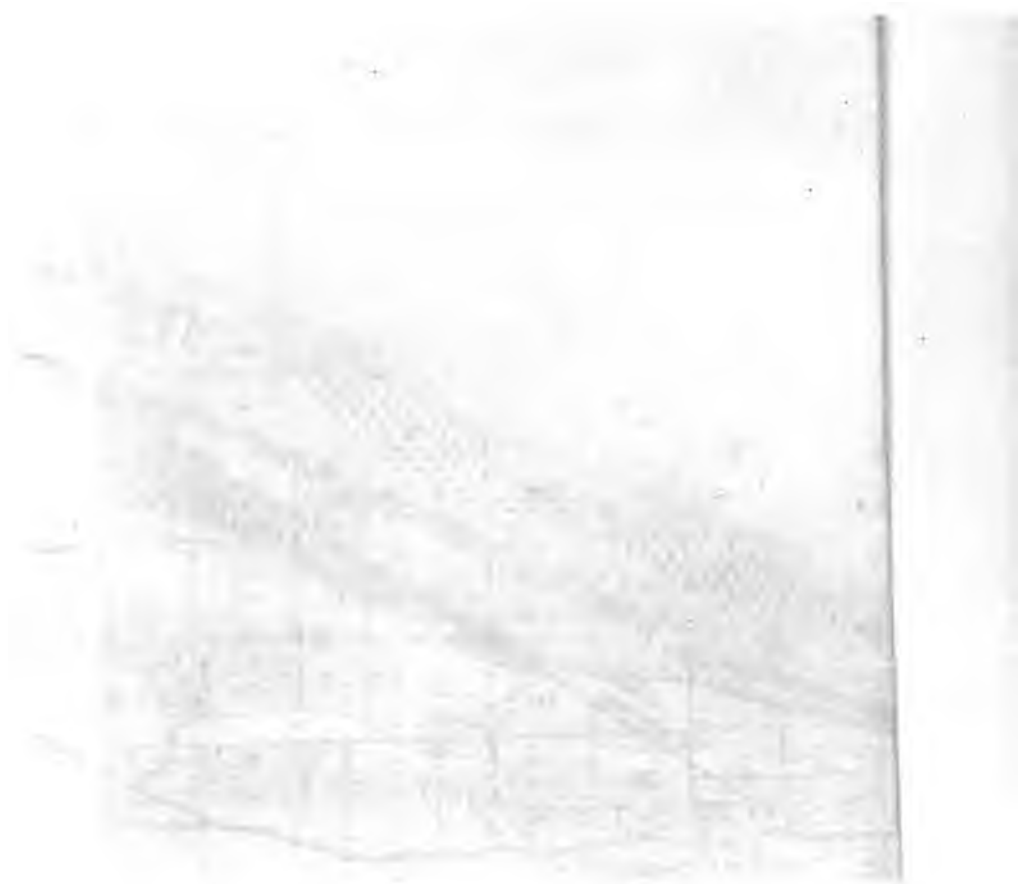
gravel. Taken in connection with the uniformity of elevation reached by the highest hills, in the Mansfield sandstone area, the Knobstone area and the Silurian area in the southern part of the State, it has been suggested by Mr. Frank Leverett, of the United States Survey, that at least southern Indiana was reduced to base level in Tertiary time. In that case the present and preglacial topography of Indiana would date from some time in the Tertiary. This Tertiary erosion might also account for the absence of Cretaceous deposits, if any such were ever laid down in Indiana. Until more study shall have been given these gravels and their interpretation, the matter of this paragraph must be considered more as a suggestion than as a demonstrated fact.

RECENT AND GLACIAL. — The present surface of Indiana is a gently sloping plain, whose extremes of level are 313 and 1,285 feet above tide. More than three-fourths of the area of the State is covered with glacial drift deposited by several successive invasions of the great Laurentide glacier. The known thickness of this drift ranges from 0 to 485 feet. Its materials are, for the most part, foreign and derived from the vast area of crystalline rocks which occupy the region in which the glacier had its source. The sedimentary rocks of the northern part of Indiana were, of course, ground down by the overriding ice, the shales being reduced to clays, the sandstones to fine sand and the limestones to drift marl. These resulting materials were thoroughly mingled, not only together, but with those from the north, and spread out in a gradually thinning mass to the southward. The soils of this glaciated area of the State are, therefore, rich in the various elements which comprise the food of plants, and require a much less outlay for artificial fertilizers than the residual soils of the unglaciated portion of southern Indiana.

This driftless area comprises all or a large portion of each of the following counties: Posey, Vanderburgh, Warrick, Dubois, Spencer, Perry, Crawford, Orange, Martin, Lawrence, Monroe, Brown, Jackson, Washington, Floyd and Harrison. In addition, small portions of Gibson, Greene, Morgan, Bartholomew and Clark are included in its bounds. The greater portion of the driftless area "and the southeastern part of the drift plain is a region of deep, narrow valleys, bounded by precipitous bluffs, and separated by sharp, irregular divides. Isolated knobs and buttes are numerous; their crests and summits being from 300 to 500 feet above the valley bottoms. The streams are rapid and broken by frequent cataracts. All open into the Ohio Valley, a trench from one to six miles wide, 400 feet deep and bounded by steep bluffs."*

* Dryer.—Stud. in Ind. Geog., 1897, 19.

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1. The first part of the document is a list of names and addresses of the members of the committee.

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THE GEOLOGY OF LAKE AND PORTER COUNTIES, INDIANA.

BY W. S. BLATCHLEY.

Occupying the extreme northwestern corner of Indiana are the two counties of Porter and Lake, together comprising 920 square miles of territory. This territory is bounded on the east by Laporte County, Indiana, on the south by the Kankakee River, on the west by Cook, Will and Kankakee counties, Illinois, and on the north by Lake Michigan.

Location and Area. According to the United States Survey, the area comprising these two counties lies in Townships 31 to 38, inclusive, north of the base line of Indiana, and in Ranges 5 to 10, inclusive, west of the Second principal meridian. Valparaiso, the county seat of Porter County, and located near its center, is in latitude 41 deg., 28 min., north, and in longitude 87 deg., .04 min., west, while Crown Point, the county seat of Lake county, is in latitude 41 deg., 25 min., .07 sec., north, and in longitude 87 deg., 22 min., 30 sec., west of Greenwich.

The two counties were at first united, but by an act of the Legislature approved January 18, 1837, that portion of their territory lying west of the center of Range 7, west, was organized as Lake County, and was declared to be independent after the 15th day of February, 1837. This division gave to Lake County an area of 500 square miles and left in Porter County 420 square miles. With its northwestern corner lying within 12 miles of the Court-house of Chicago, the area comprised in these two counties is destined to become as valuable as any of equal size in the State of Indiana.

GENERAL PHYSIOGRAPHY.

In the present paper we have to deal principally with the physiography or surface features of the area under consideration since not a single outcrop of paleozoic rock is known to occur in the two counties. Their 920 square miles is a *plain of accumulation*, being everywhere covered with a sheet of glacial drift ranging in known thickness from 90 to 141 feet.

If a person could rise in a balloon so as to get a bird's eye view of this plain, or if he would traverse it from north to south at intervals

of a few miles, he would see that it comprises three distinct belts or regions, each with well-marked surface characteristics. The region on the north and the one on the south would each be seen to be lower, and comparatively much more level than the one intervening. Along the upper margin of the northern region would be noted, however, a narrow strip covered with numerous hills and ridges of sand. The surface of the middle region, comprising more than half of the entire area, would in some parts be seen to be high and undulatory, in others more even and regular, but on the whole much more rugged and broken than either of the other two. To these regions the following names may be applied:

1. **THE CALUMET OR NORTHERN REGION**, so called because the Calumet River flows east and west through its full width, comprises approximately 250 square miles, 162 of which are in Lake County and 88 in Porter. On the western border of Lake this belt is 15 miles wide, but it narrows as it passes to the northeast until it is but eight miles in width, where it passes into Porter County, and but seven miles where it leaves that county at the northeastern corner. This region, as we shall see, owes its surface configuration partly to a former extension of Lake Michigan southward, and partly to the action of the wind on the sand thrown up by the present lake.

2. **THE MORAINIC OR MIDDLE REGION**. Four hundred and eighty-five square miles of the surface of the two counties are comprised in this belt, about 250 of which lie in Lake and the remainder in Porter. The higher altitude and more rugged surface of this area is due to its being covered with a much thicker mass of glacial debris which was dropped where it now lies by a lobe of the great Laurentian ice-sheet. Since its deposition its surface has been modified only by wind, frost and erosion by small streams. On the western border of Lake County this belt of drift is 17 miles in width. Where it passes into Porter County its width is approximately the same. In that county it trends to the northeast and gradually narrows until at the point where it leaves the county it is but about seven miles in width.

3. **THE KANKAKEE BASIN OR SOUTHERN REGION**. The remaining 185 square miles of the two counties are comprised in this region, 80 of them lying in Lake County and 105 in Porter. In the former county most of this area is marsh land, which up to the present has not been drained sufficiently for thorough cultivation. In Porter County the marsh area is much less, a large part of the Kankakee basin, being composed of rich, and at present, well drained prairie lands. A more detailed account of each of these regions will follow hereafter.

THE UNDERLYING ROCKS.

If through the great sheet of drift which covers the surface of Lake and Porter counties a bore be driven, as has been done in a number of places, solid or bed rock will be struck at varying depths. In Porter County and in the eastern two-thirds of Lake County this rock has been found to be the black Genesee shale of the Devonian age. In the south half of the western third of Lake County it is the Lower Helderburg limestone, while in the north half of the same area it is the Niagara limestone, both of the Upper Silurian age. Whatever its nature the formation immediately underlying the drift was, at one time, laid down as sedimentary rock in the bottom of a shallow sea, and several millions of years ago, was raised into dry land.

The black shale, which, during a very long period, formed the surface over the greater portion of this area, when first brought up from the deep bores in Porter and Lake counties, has a black to bluish gray color, but an exposure to air soon changes to a light gray or drab. It is a soft material, easily pierced by the drill, and is composed mainly of very fine grains of sand (silica) and alumina cemented together by iron (ferric) sulphide and thoroughly saturated with bitumens. The proportions of these constituents are shown in the following chemical analysis of a sample of the shale from New Albany, Indiana:*

ANALYSIS OF GENESEE SHALE.

Water expelled at 100°C.....	0.50
Volatile organic matter (bitumen).....	14.16
Fixed carbon (bitumen)	9.30
Silica	50.53
Pyritic iron and alumina.....	25.30
Calcium oxide	0.09
Magnesium oxide	0.12
Total	100.00

The bitumens doubtless owe their presence in the shale to the slow decomposition of a vast number of marine plants and animals which were deposited with the sand and iron sulphide by the turbid waters of the old Devonian seas. Once so deposited these organisms did not decay as do animals on land, since by the waters above and the mud and ooze about them they were shut off from the free oxygen of the air which is the principal agent in decay. They underwent, instead, a process of slow decomposition, the products or residue of which are

*See article by Hans Duden, in 21st Annual Report, Department of Geology and Natural Resources of Indiana, 1896, 106-119. entitled "Some Notes on the Black Slate or Genesee Shale of New Albany, Ind."

known as bitumens. These bitumens in time saturated the surrounding sediment and gave to it its distinctive black color. They have since remained closely associated with this sediment, which, by great pressure, has been compressed into shale or laminated clayey rock.

The bitumens, when separated by distillation or otherwise, will burn readily with a bright flame and without leaving a residue.* On account of their presence the shale itself may be set on fire and will burn until the bitumens are consumed. The sand, alumina and iron sulphide being non-combustible, the shale retains its shape after the bitumens are burned out, but is changed in color to a reddish brown. On account of this property of partial combustibility, the black shale is often mistaken for coal by persons who are unacquainted with its true nature.

This Genesee shale is known to be the formation immediately underlying the drift over quite a large area of the two northern tiers of counties in Indiana. In a strip eight to fifteen miles wide, extending from Jasper County in a southeasterly direction to the Ohio River at New Albany, it also lies next below the drift or forms the surface rock. West of this strip it lies at greater depths beneath the Subcarboniferous and Carboniferous limestones and shales which comprise the surface rocks of Southwestern Indiana. Its thickness as noted at a number of points in the State is as follows:

New Albany	104 feet.
Salem	103 feet.
Seymour	115 feet.
Bridgeport	124 feet.
Goshen	140 feet.
South Bend	95 feet.
Valparaiso	65 feet.
Crown Point	112 feet.

This shale undoubtedly once covered a much larger area south and east of the ones above mentioned; but during the long interval between its rise above sea level and its burial beneath the drift, that area was reduced by extensive erosion.

The Lower Helderberg, which lies next to the drift in the southern half of the western third of Lake County, is a buff or gray cherty limestone. Where it is exposed by erosion it is often irregular and uneven in its bedding. The best exposure of this formation in Indiana is along the Wabash River above and below the City of Logansport. Further northwest it comes near the surface at Monon and Rensselaer, in Indiana, and in Kankakee and Iroquois counties, Illinois.

* Mr. Duden, by a process of distillation, obtained from 8.5 pounds of the shale 65 gallons of 22 candle-power gas. He also states that in Scotland, in 1890, 62,500,000 gallons of crude petroleum and 25,000 tons of sulphate of ammonia, the latter a valuable fertilizer, were made from a similar shale.—*Loc. Cit.*, pp. 113-114.

The Niagara has been found by borings to underlie the drift in the vicinity of Hammond, Lake County, and between there and Chicago. Over a large portion of the eastern half of Indiana it also forms the surface rock. It is a bluish or buff, sub-crystalline limestone, usually

*The
Niagara
Limestone.*

rich in the fossil remains of those marine animals common to the epoch of its formation. Near Chicago this limestone contains much petroleum, but in such a minutely diffused state as to be wholly without value.

Could all the drift be removed from the surface of Lake and Porter counties the elevations of the different portions of the exposed surface would be found to vary but little, and the three formations—Genesee Shale, Lower Helderberg and Niagara limestones—would be exposed as the surface rock, each occupying its respective area above mentioned. If the black shale could in turn be stripped from the area which it covers, beneath it would be found the Lower Helderberg, and beneath that the Niagara.*

GLACIERS AND GLACIAL DEPOSITS.

In the surface rocks below the drift which covers Lake and Porter counties there doubtless exist many shallow valleys and perhaps some deep ones, remnants of those of pre-glacial days. For, be it remembered that during thousands—aye, millions—of years, these surface rocks were once dry land. Decay and erosion were in action then as they are to-day. Sunshine and rain, wind and frost, trickling rills and strong streams, were ever at work, softening and sculpturing and wearing down the exposed rocks—forming clays and sand and gravel and bearing them away to lower levels. At the close of that period this area of surface rock resembled, probably, that of to-day in the driftless area of southern Indiana, being cut up by erosion into a complex network of valleys, ridges and isolated hills. Over these was a soil—formed from decaying rocks and vegetation—poorer, perhaps, than much of that which at present covers the surface of the two counties—resembling closely, perhaps, that now found in Scott, Jennings and Floyd counties, where the black shale has been the parent rock.

During this long period of erosion and decay mild climatic conditions had prevailed. But a change in these conditions came gradually to pass. For some, as yet unknown, reason the mean annual temperature of the northern hemisphere became much lower. The climate of

*Between the Genesee shale and the Lower Helderberg might be found the Upper Helderberg, and between the Lower Helderberg and Niagara the Waterlime. But in Indiana the Upper Helderberg is often very thin or altogether wanting, while in the northern counties of the State the Waterlime is so similar to the Lower Helderberg that the two are difficult to distinguish.

the regions to the east and south of Hudson's Bay became similar to that of Greenland to-day, or even colder. The snow, ever falling, never melting, accumulated during hundreds of centuries in one vast field of enormous thickness. Near the bottom of this mass a plastic, porous sort of ice was gradually formed from the snow by the pressure from above. This ice mass or glacier took upon itself a slow, almost imperceptible, motion to the south and southwestward. As it moved thus onward great masses of partly decayed rock and clay from hillsides and jutting cliffs rolled down upon it and were carried on and on until, by the melting of their icy steed, they were dropped hundreds of miles from the parent ledge. Large, irregular masses of rock from the region in which the glacier was formed were either frozen into its nether portion or rolled along beneath it, and as the ice sheet moved they served as great stone drags, grinding down and smoothing off the hills and ridges and filling up the valleys, until the irregular, uneven surface of the old preglacial rocks was planed and polished. In many places these imprisoned rocks cut deep scratches or grooves—the so-called “glacial striae”—in the surface ledges over which they passed. These, to the geologist, are excellent exponents of the direction in which the glacier moved.

From these striae, and from other evidence which it is difficult to otherwise explain, it is now believed that there were several distinct epochs in the glacial period. The great ice sheet which was first formed several times advanced and as often—by an increase in the temperature of the region which it entered—melted and receded; its retreat or recession being each time as gradual as its advance had been. Like a great army which has attempted the invasion of a country and has been compelled to withdraw, it would again assemble its forces and start in a slightly different direction. But perchance before it had reached the limit of its former invasion a force of circumstances would render a retreat necessary. Its advancing margin was not a straight line, but in lobes or long, gradual curves. Mr. B. F. Taylor has given the following graphic description of the ice sheet at the time of its greatest advance into the regions now comprising Indiana:*

“When the glacier covered most of Indiana the ice was at least 500 or 600 feet deep over the present site of Terre Haute, and nearly as deep over that of Indianapolis, and it thickened gradually northward. If an observer could have stood on one of the hills in Brown County at that time he would have seen to the east of him the great wall of the

*Studies in Indiana Geography, 1897, 102.

ice front extending south towards Kentucky, while to the west it would have been seen in the distance stretching away towards the southwest. For hundreds of miles to the east and west, and for 2,000 miles or more to the north, the glaring white desert of snow-covered ice, like that seen in the interior of Greenland by Nansen and Peary, would have appeared, stretching away out of sight with not a thing under the sun to relieve its cold monotony. It is hard to think of Indiana and her neighboring sister States as being clothed in such a shroud-like mantle as this. But it was in large part this same ice sheet, coming perhaps four or five times in succession, that covered the State with the inexhaustible soil of the drift, and made Indiana the fertile agricultural State that she is to-day."

Whenever a glacier has reached the limit of its advance and there halted a sufficient length of time to deposit a large amount of debris, such an accumulation is called a terminal moraine. This moraine does

A Terminal Moraine. not consist, as is often supposed, of numerous large bowlders, which have been dropped on the surface in more or less regular concentric lines. Such bowlders are only an accompaniment, and constitute but a very small fraction of the moraine proper. The main portion usually consists of a thick bed of compacted tough clay in which are many pebbles and bowlders of small size, and often pockets of gravel and sand. Such a moraine may be a number of miles in width and consist of many small parallel ridges, or it may have a number of subordinate ridges branching off in every direction from the main one. These "unite, interlock, separate, appear and disappear in an intricate and eccentric manner. Several of these subordinate ridges are often plainly discernible. It is usually between them and occupying depressions caused by their divergence that most of the larger lakes embraced in the moraine are found. The component ridges are themselves exceedingly irregular in height and breadth, being often much broken and interrupted."* When very complex the term "morainic system" is often given to a terminal moraine.

As already noted, a large area of the present surface of Lake and Porter counties is covered by a portion of a terminal moraine possessing many of the characters above described. The city of Valparaiso is located near the crest of the main ridge, and for that reason the name "Valparaiso moraine" has been ascribed to it. According to Frank Leverett,† who has made a special study of a portion of this moraine, it begins near the Illinois and Wisconsin line and extends southward through portions of Lake, McHenry, Cook, Dupage and

* Chamberlain, T. C.—Third Ann. Report, U. S. Geol. Surv., 1883, 311.

† See Bull. Chic. Acad. Science, No. 2, 1897, p. 26.

Will counties, Illinois. In Will and southern Cook counties it turns to the southeast and enters Lake County, Indiana, from the southeastern portion of Will County. Throughout this course it ranges from ten to fifteen miles in width, and its inner border lies nearly parallel to the shores of Lake Michigan and distant from it about 12 miles. Its leading features in Lake and Porter counties will be described more in detail hereafter.

*The
Valparaiso
Moraine.*

From Porter County it extends northeasterly across Laporte County, the town of Otis lying near its inner margin. Still pursuing a northeasterly course, it extends through portions of Berrien, Cass, Kalamazoo, Barry, Kent, Ionia and Montcalm counties, Michigan, beyond which it has not been definitely traced. In the words of Dr. Chamberlain:* "It may be likened in a general manner to an immense U, embracing the great lake between its arms. This gigantic loop is over 200 miles in length and from 90 to 150 miles in width. The parallelism of this moraine to the lake shore is one of its most striking features."

Each of the great divisions or lobes of the main glacier has been given a special name by those geologists who have studied the limits of its advance. The division which once partly covered the area now comprising Lake and Porter counties is known as the Michigan lobe—its outline having roughly corresponded to the area at present occupied by Lake Michigan. Over the area now covered by the Valparaiso moraine other ice sheets had, no doubt, previously advanced and receded, but that moraine, as now limited, is due to the last advance of the great Michigan lobe. The final retreat of this lobe was towards the northeast.

As it slowly receded it left between the border of the inner slope of the Valparaiso moraine and the edge of the retreating ice a low area, which was soon covered with water from the melting glacier and from rainfall. A lake was thus formed whose waters were dammed

*Formation
of Lake
Chicago.*

up on the north and northeast by the ice of the retreating glacier, and on all other sides by the moraine which this glacier had left behind it. This lake continued to rise until it overflowed the moraine at its lowest point, which happened to be to the southwestward, near the present city of Chicago. At this point a channel was eroded, through which, for a long period, the waters of the glacial lake found their way to the Des Plaines River, and thence by way of the Illinois to the Mississippi. To this channel has been given the name "Chicago Outlet," and the glacial lake which formed it is known in geological literature as "Lake Chicago."

* Third Ann. Report U. S. Geol. Surv., 1883, 322.

The area of this lake was necessarily a variable one; since the ice dam on the north was all the time slowly receding. However, the name Lake Chicago is applied to all its stages* from the time of the first opening of the Chicago outlet until its final closing on account of the overflow of the Great Lakes, finding for itself a new channel through the Niagara River.

On the south, Lake Chicago, during its first stage, extended into Lake County as far as the high sandy ridge passing east from Dyer through Schererville. East of this ridge the southern border of the lake lay south of Turkey Creek and Deep River, in the northern part of Ross Township. In Porter County it turned sharply to the northeastward, following the border of the moraine to near the center of section 18, Portage Township, then southeast up the valley of Salt Creek to section 32, where it again turned to the northeast. According to Leverett, who has studied carefully the limit of the lake in this region, the sand ridges which lead northeast from Crissman mark the southern limit of the lake proper in Porter County, so that the plain along Salt Creek and east from there to Chesterton and a narrow strip northeast of Chesterton along the Calumet River to near the line of Porter and Laporte counties was covered by a nearly enclosed shallow bay. This bay apparently opened into the lake proper at the Little Calumet, in section 31 (37 north, 6 west). There was probably a similar bay east of Deep River and south of the village of Lake, which opened into Lake Chicago at the head of Turkey Creek, south of Griffith.

I. THE CALUMET OR NORTHERN REGION.

The high ridge which was mentioned above as being the limit of Lake Chicago near Dyer, is but one of three prominent ridges or beaches which mark in part the old shore line of that lake in Lake and Porter counties.

The one at Dyer is the upper beach thrown up by the first stage of the lake. To it the name of Glenwood Beach has been given by Mr. Leverett,† since the beach is well exposed near the town of that name, a few miles south of Chicago. In Illinois it has been traced by Leverett from the Illinois-Wisconsin line. North of South Waukegon it lies but one or two miles from the present shore of Lake Michigan. Between Waukegon and Winnetka the beach has been cut away by the encroachment of the waters of Lake Michigan. Below Winnetka it extends a little south of west through Oak Park, Maywood, and La Grange, to near

* Leverett—Bull. Chic. Acad. Science, No. 2, 1897, 65.

† See Bull. Chic. Acad. Nat. Science, No. 2, 1897, 66, *et seq.*

Willow Springs, where it turns to the southeast. Between Willow Springs and Glenwood it is not prominent, the old shore line being "carved on the inner face of the Valparaiso moraine, with banks 5 to 20 feet or more in height, but with only occasional deposits of gravel and sand." Near Glenwood, in the northwest quarter of section 25, (36 north, 13 east), the beach line diverges from the moraine and from this point to Dyer lies from one to two miles to the north of its border. Throughout this distance the beach is composed mainly of deposits of sand and gravel thrown up to a height of 6 to 15 feet above the surrounding surface. In many places these deposits are spread out over an area a half mile or more wide, in the form of small parallel ridges with numerous depressions or sags intervening.

At Dyer, 15 miles due south of the Illinois-Indiana cornerstone, the beach enters Indiana. Here the small ridges have combined into one prominent one, composed mainly of fine sand, whose crest rises rather abruptly 25 to 40 feet above the lowlands of Cady Marsh to the north. The level of the base of the ridge, where crossed by the Monon Railway at Dyer, is 636 feet above tide, so that the crest of the ridge is 80 to 95 feet above the present level of Lake Michigan. The width of the crest itself is but 40 to 70 feet, this distance being practically level. On the south side the slope is much more gradual than on the north, the entire width of the base being 40 to 60 rods. This ridge continues unbroken due east from Dyer about two and a half miles. Small trees of the black oak, *Quercus velutina* Lam., and thickets of crab-apple and other shrubs cover its slopes and crest throughout this distance and have prevented the moving of the sand by the wind. A mile west of Schererville the continuity of the ridge is broken. Sand hills or dunes begin, some of which are 25 to 30 feet in height. These extend two miles east of Schererville, where they end in section 12 (35 north, 9 west).

From this point the shore of the first stage of the glacial Lake Chicago no longer coincides with the beaches which owe their origin to it. The former, as already mentioned, passes to the eastward south of Turkey Creek, while Glenwood Beach sets in again near Griffith, and extends in a northeasterly direction through Ross. A mile and a quarter beyond this station, in section 29 (36 north, 8 west), it joins the Middle or Calumet Beach. Between Griffith and this junction the Glenwood Beach is a half mile or more wide and is composed of several broken ridges of dunes, covered with small black oak timber. Beyond the junction the two beaches—Glenwood and Calumet—lie side by side and trend northeastward to near the Calumet River, two miles northeast of Crissman, Porter County, where they suddenly terminate. Between the station of Lake and this terminal point these two beaches



Calumet Beach near Highland, Lake County, Indiana.



Hart Ditch, cut through Calumet Beach, 1¼ miles west of Highland, Lake County, Indiana.

VIEWS OF CALUMET BEACH.

consist of two or more parallel ridges, each 20 to 30 feet above the depression between them. Several smaller ridges lie also parallel to and north of them.

North of the Calumet River, in Westchester and Pine townships, Porter County, the two beaches are in places separated by a narrow marsh lying just north of the Michigan Central Railway. East of Furnessville the Glenwood Beach lies mainly south of the Michigan Central Railway, while the Calumet Beach lies north of it as far eastward as the vicinity of the Northern Indiana Penitentiary, in Laporte County. Over most of this distance their combined width is about three-fourths of a mile. Between their northern limit and the Lower or Tolleston Beach, lying to the northward, is a great marsh, eight miles long by one-half mile wide, which extends from Michigan City westward to old City West. (See map.)

For so probably that of a great recession of the ice dam to the north of the glacial Lake Chicago, accompanied, perhaps, by a lowering of elevation far to the northeast and the cutting of an outlet in that direction, the waters of Lake Chicago ceased for a time to flow through the Chicago Outlet. They withdrew wholly from the area which they covered in Lake and Porter counties—and even a large part of the southern end of the present Lake Michigan is supposed to have been dry land.

After a long period, by another glacial advance, or an elevation of the territory embracing the northeastward outlet, perhaps both, the waters of Lake Chicago again advanced southward and began to flow through the southwestward outlet. A new beach was thrown up north of the old Glenwood Beach. Since it lies close to the Calumet River throughout much of its course the name "Calumet Beach" has been ascribed to it.

In Illinois, according to Leverett, it is difficult to distinguish from the upper beach until the Chicago River is reached. Between the Chicago and Des Plaines rivers it lies from one and one-half to three miles distant from the Upper beach, but follows the same general direction. At Summit it turns to the southeastward and follows that direction to the north end of Blue Island ridge, where it turns southward and passes by Washington Heights to the Calumet River east of Blue Island. Then ensues a break due to the location of the old Sag Outlet, through which Lake Chicago discharged. East of this break, near the Illinois Central Railway, the beach again appears, and, passing eastward through Lansing, crosses the State line into Indiana about one and a half miles south of the Little Calumet River. Continuing eastward along the north border of Cady Marsh, it passes through Highland,

and, as already noted, joins the Upper or Glenwood Beach northeast of Ross. Beyond this point its course through Lake and Porter counties practically parallels that of Glenwood Beach and has been traced in connection with it.

Between the State line and the junction above noted the Calumet Beach consists of a single prominent ridge of sand, possessing practically the same characteristics as the Glenwood Beach east of Dyer. Its north slope is much more abrupt than the south one, and the crest ranges from 25 to 35 feet above the Calumet Plain to the northward. Just west of Highland this crest is 150 yards wide. Where excavations have been made by burrowing mammals many coarse pebbles and pieces of limestone an inch or more square have been thrown out, suggesting a mixture of gravel with the sand some distance below the surface.

At the crossing of the Hart ditch, one and a fourth miles farther west, a cut is made 45 feet deep through sand alone. The crest is here about 140 yards wide, and the base probably as wide again. This ridge, with its wooded crest standing so high above the great treeless Cady Marsh on the south and the Calumet Plain on the north, is a prominent feature of this section of Lake County. The elevation of its crest at Highland is 55 feet above Lake Michigan.

Once again the waters of Lake Chicago receded and for a time stopped flowing through the Chicago Outlet. When they again advanced they threw up the third of these prominent sand ridges, called the Lower or Tolleston Beach, since it passes through the Indiana town of that name. It has been traced by Leverett from Evanston, Illinois, south through Rose Hill Cemetery to Lincoln Park, Chicago, beyond which it is obliterated for quite a distance. From Englewood it passes southeasterly to Hyde Park, and then south near Pullman, Kensington and Riverdale. Near Dolton, south of the Calumet River,

The Lower it turns more to the eastward and enters Indiana in section
or Tolleston 12 (36 north, 10 west), less than two miles south of Ham-
Beach. mond. Trending eastward, it passes through the villages
of Hessville, Tolleston and Miller's, in a line about mid-

way between the Little and Grand Calumet rivers. East of Miller's it deflects slightly to the northward and through Porter County lies parallel to the present shore of Lake Michigan, and distant from it nowhere more than a mile. It has here, however, been largely covered by the dunes of the present lake so that it is difficult to distinguish from these later deposits. In its extent through Lake County this beach is composed of a broken ridge of sand dunes varying in height from 20 to 30 feet, and covered with dwarf black oak and other trees and shrubs peculiar to a sandy soil.



CALUMET BEACH.

Showing out of Hart Ditch and wagon bridge, Lake County, Indiana.

In both Lake and Porter counties all that interval lying between Tolleston Beach and Lake Michigan is covered with sand, there being no such broad, level plains as occur along the Little Calumet, between the Calumet and Tolleston beaches, and along Cady Marsh between the Upper and Middle beaches. In Porter County, as already noted, this interval is covered with high sand dunes. North of Miller's such dunes also cover most of the area, but west of that station a series of

Low low beaches or sand ridges appear which lie parallel to
Beaches. Tolleston Beach and cover the whole interval between it and the present lake. These beachlets, for the most part,

rise but 8 to 15 feet above the level of Lake Michigan and are 6 to 10 rods in width, with narrow swamps or swales intervening, which become dry in summer. Leverett has counted 32 of them on the line running north from Hessville. They were evidently formed after the waters had ceased to flow through the Chicago Outlet and hence were thrown up by the waters of Lake Michigan rather than those of Lake Chicago.

Similar low beaches are found in the vicinity of Jackson Park and Englewood, Illinois. Between their southern ends and the western ends of the beaches in Lake County a low sandy plain intervenes whose surface is nowhere more than 10 feet above the present level of Lake Michigan. This is supposed to have been an open bay at the time the beachlets were forming, but has since been partially filled with sand, leaving Lakes George and Wolf, in Indiana, and Calumet, in Illinois, as remnants of its waters.

West of Hobart, and included within the area supposed to have been covered with the waters of Lake Chicago, is a morainic ridge about four miles long by one mile wide. Its surface is higher than that of the surrounding country and covered with glacial till. This ridge was evidently an island whose surface lay above the waters of Lake Chicago at the time of its highest stage.

Beneath the sand north of Tolleston Beach occasional layers of gravel are struck at varying depths, and mingled with these, as well as with the sand, are numerous remains of fresh water mollusks, both univalve and bivalve. But little data was available concerning the thickness of the sand. Well sections at Liverpool show it to extend to a depth of 10 to 16 feet; at Lake 20 to 22 feet, and at the powder works, near Miller's, 40 feet. At Hammond, where it ranges from 23 to 30 feet, it overlies a blue pebbly clay, 60 to 85 feet in thickness. This clay appears more homogeneous and finer-grained, and less tough and compacted, than that found underlying the Valparaiso moraine, farther south. These qualities are probably due to its deposition by the waters

of Lake Chicago, the finer particles as they settled down from suspension in water having been distributed more uniformly than if dropped by a melting glacier. Beneath this clay lies the Niagara limestone or surface rock of preglacial age. Aside from the dunes the sand will probably vary from 20 to 40 feet in depth and will be found to overlie the subaqueous clay above mentioned throughout most of the area north of the Lower Beach.

Within the area covered by the bays of Lake Chicago mentioned on page 33 there are large deposits of a very fine-grained silt or marly clay. Of these the one near Hobart is best known, having been exposed in a large pit to a depth of 25 feet, and pierced by a bore 132 feet without reaching its base. It is a dark drab in color, becoming lighter by exposure. As is customary with such deposits, it lies in thin layers, two to nine inches thick, separated by a slight coating of sand. It contains quite a percentage of lime disseminated evenly through it, and for this reason burns to a whitish or cream color. It is wholly free from pebbles or impurities of any kind, and is extensively used at Hobart for the making of pressed front brick and terra cotta lumber.* This silt is exposed at Garden City, on the county line two miles southeast of Hobart, also at several points north of Porter and Chesterton along the Calumet River. It has also been found in a number of wells in the western part of Portage Township, Porter County.

The northern limit of Lake and Porter counties comprises 33 linear miles of the southern beach line of Lake Michigan, one of the grandest bodies of fresh water on the globe. Along this beach was for years the only public road in the area now comprising the two counties, all overland communication between Ft. Dearborn—Chicago—and Detroit in the early part of the present century having been along its sands.

The limits of this beach line are ever changing. Water and wind are, every second, tearing from it in one place and adding to it in another. From Michigan City southwest for ten or more miles the removal is probably greater than the accumulation, but along the remainder of the Indiana shore the beach line is being widened. In the latter portion a person walking along the margin of the water can see that each wave throws up a minute ridge of sand, so minute, in fact, that it is scarcely visible. Perhaps the next succeeding wave carries it away. But if it be thrown high enough to remain unmolested until it has time to dry, its particles are caught up by the wind and carried farther inward. In most cases they are piled up for a

* For analyses of this clay and a more detailed account of its uses see the article entitled "The Clays and Clay Industries of Northwestern Indiana" in the present volume.

time along the foot of a ridge or dune, which is found from 50 feet to 100 yards back from the water. If a stiff breeze be blowing, the traveler over this beach is bombarded by the fine, sharp-edged particles of sand, many of which strike against his face and produce a stinging sensation. These grains are composed of small angular pieces of quartz and have a light-brownish tint.

The amount of this sand which has been thrown by the waves of Lake Michigan on to the shores of Porter and Lake counties has been computed by Dr. Edmund Andrews,* as follows: "For 25 miles west from Michigan City the beach maintains an average cross section of about 6,000 square yards, and its contents are 264,000,000 cubic yards. In this division the beach is in the form of a lofty belt of sand dunes, about one-third of a mile wide and in places 160 to 200 feet in height. In the next eight miles west (extending to the Indiana line) the beach spreads out into a broad belt of low parallel ridges, about two miles in extreme width. This division has a cross section of about 16,000 square yards, after deducting the sand which was deposited by Lake Chicago. Its contents amount to 225,280,000 cubic yards." It will thus be seen that at a low estimate half a billion cubic yards of material have been added to the surface of these two counties by the waters of the present lake.

The dunes constitute the most striking and characteristic feature of the shore line. They are great sand ridges, sometimes continuous for a mile or more, but more often broken or cut by "blow-outs" into isolated rounded hills. The highest of these hills in Porter County

*The Sand
Dunes.*

is Mt. Tom, in section 12 (37 north, 6 west), northwest of old City West. Its crest is 190 feet above Lake Michigan. Northeast of Miller's, Lake County, are a number reaching a height of 150 feet above the lake. In some places, notably about Dune Park, Porter County, the ridges are for long distances wholly destitute of vegetation. Their bared surface, 50 to 100 feet in height, with the sand piled just as steeply as it will lie, gleams and glistens in the sunlight and reflects the summer's heat with unwonted force. Other ridges and rounded hills, especially those back some distance from the lake, are often covered with black oak, northern scrub pine (*Pinus banksiana* Lambert), stunted white pine (*Pinus strobus* L.), and many shrubs and herbs peculiar to a soil of sand. The roots of this vegetation form a network about the sand grains and prevent the leveling of the dunes. In time, however, a tree is uprooted, or a forest fire burns off the vegetation. The protecting network of rootlets is destroyed. A bare spot results over which the winds freely play. A great storm from the north or northwest scoops out a small

* Quoted by Leverett in Bull. Chic. Acad. Sci., No. 2, 1897, 80.

bowl-shaped cavity, and, carrying the sand either south or southeastward, drops it over the hillside. The cavity is cut deeper and wider by succeeding storms, and a great "blow-out" in time results. Where a few years before stood a high hill or unbroken ridge now exists a valley, or a cavity in the hillside, acres, perhaps, in extent, and reaching nearly to the level of the lake. The sands which once were there now constitute new hills or ridges which have traveled, as it were, a greater distance inland. In many places the drifting sands have wholly or partly covered a tall pine or oak tree. Where but partly covered, its dead (sometimes living) top projects for a few feet above the crest of hill or ridge. One may rest in its shade and not realize that he is sheltered by the *upper* limbs of a large tree whose trunk and main branches lie far beneath him embedded in the sands.

But few forms of animal life dwell among these dunes. Vegetation is not plentiful enough to furnish sustenance. A lizard scampering rapidly along will sometimes be seen, but even they are scarce. The twitter and chirp of bird is seldom heard. Insect life is less abundant than in any area of equal size in the State. Back, away from the sound of the breaking waves, a peaceful quiet pervades. There may one sit and literally watch the growing of the hills. There will he come to realize, as never before, how the slow, unceasing action of some of nature's milder forces have modified to so great an extent the surface of the earth. Around him on every side is matter—sand. Coming in from over the lake is the force—wind. Slowly but surely building up about him is the result of the action of the force on matter—hills. Thus have dunes been formed, here or elsewhere, for ten thousand times ten million years.

Where the gravel road from Hobart strikes the lake north of Miller's is a portion of the beach which is destined to become a noted resort. It is 150 yards or more wide, with a gradual slope from the foot of the first ridge to the water. The bathing is excellent. The scenery about the Calumet, the mouth of which is but a short distance away, is very fine, while from the tops of near-by dunes one can obtain some magnificent views over Lake Michigan, or over the rugged surface to the south and east.

Another portion of the beach which affords fine bathing and some excellent scenery lies north of Furnessville, but the facilities for reaching it are, at present, not of the best.

Between the station of Pine, Lake County, and the State line no dunes occur, and the present beach, i. e., the one washed by the waves of storms, is, in general, much narrower than that to the eastward. Along most of this distance the water line is closely paralleled by three



1. Down the Calumet, north of Miller's, Ind.
2. A sand ridge northwest of Duno Park, Ind.
3. The shore of Lake Michigan, east of Whiting, Ind.
4. A sand flat, with swamp and hill in distance.
5. Bridge across the Calumet, north of Miller's, Ind..
6. Down the Kankakee, from the Monon Railway, Lake Co., Ind.

VIEWS IN LAKE AND PORTER COUNTIES.

railways, whose artificial roadways are in places protected by piling. In places east and west of Whiting large amounts of refuse slag from the furnaces of the Illinois Steel Company at South Chicago have been dumped to prevent erosion. The presence of this slag and piling detracts greatly from the natural beauty of the lake front.

Near the shore the bottom of Lake Michigan is uniformly covered with sand. At the shore line this sand is about ten feet deep and it extends out to where the water reaches a depth of about 35 feet. Be-

The Sand Supply. yond this depth of water the lake bottom is composed of a stiff, tenacious blue clay, which is said to contain partings or pockets of sand, from whence, in part, comes the supply which is constantly being carried shoreward by the

waves. Much of the sand is doubtless blown from the dunes by south winds back over the lake, and, falling on its surface, is again brought to land. Moreover, by storms and by ice jams in the spring, all projecting points along the lake are slowly worn down and the material composing them is carried out to be again returned and built up in a new place. Thus much of the sand is in constant circulation, and the necessary new supply is not so great as it appears to be.

Much gravel, consisting of pebbles ranging in size between a hen's egg and a small marble, is washed up by the waves to within a foot or two of the water margin. In many places it is raked out by hand and carted beyond the reach of the high storm waves, and afterwards loaded and shipped by rail to Chicago, where it is used in roofing and concrete pavements. The immediate source of this gravel is doubtless the blue glacial till which forms the greater part of the floor of the lake, since the composition of the pebbles plainly show that they came originally from formations which lie far to the northward.

Thousands of trainloads of sand are annually shipped to Chicago from the dunes of the present lake, as well as from the ridges near Tolleston and Griffith. It is mainly used in elevating the beds of railways and in filling lots. Much money has been realized from its sale by parties who, years ago, had the foresight to purchase large areas of the dune land, then considered almost worthless.

This northern region of the two counties is drained by the Calumet River, a stream peculiar for the direction of its flow, its low banks and the sluggish motion of its waters. Except near its source it resembles more a great artificial ditch than a natural waterway.

The Calumet River. Its banks, where present, are seldom more than 10 feet above the water level. Its head waters are in Laporte County, but close to the Porter County line. Entering the

latter county in the southeast corner of section 25 (37 north, 5 west), about one-half mile north of the northern border of the morainic

region, it flows westward across the two counties and leaves the State at the southwest corner of section 12 (36 north, 10 west), but three miles south of the line of its entry into Porter County. From this point its direction is northwesterly for about seven miles to the bluff at the southeastern corner of Blue Island, Cook County, Illinois. Here, turning on a sharp curve, it flows first northeast, then southeast, and, crossing once again into Lake County, continues for 14 miles almost due eastward until it empties into Lake Michigan at the northeastern corner of section 31 (37 north, 7 west), but two miles north and two west of where it first entered Lake County. About a half mile above its mouth, where crossed by the road leading from Miller's to the lake beach, it is about 300 feet in width, and runs between some lofty sand ridges. In August, 1897, its waters at this point were shallow and almost filled with aquatic vegetation.

To distinguish the two parallel portions crossing Lake County, the southern has received the name Little Calumet and the northern, Grand Calumet. The former lies between the Calumet and the Tolleston beaches of the glacial Lake Chicago, while the Grand Calumet lies north of, but parallel to, the Tolleston Beach until the latter comes so close to the present lake shore as to head off the stream and force it to flow into the lake. The singular course of the Calumet through the two counties is wholly determined, therefore, by the presence and trend of these ancient sand ridges, and by a morainic ridge lying north of the greater part of its length in Porter County.

One other peculiarity of the Calumet is its apparent possession of two mouths. It is a double-headed monster. The Indiana mouth above mentioned is the original one. The other empties into (or receives from) Lake Michigan at South Chicago, and a channel from that point passes between Calumet and Wolf Lakes and connects with the river proper near the south line of section 31 (37 north, 15 east), about four miles northwest of the center of the city of Hammond. This channel is said to be artificial and to have been opened by Indians about 90 years ago. They pushed their canoes on one line through the marshes until a permanent channel was worn, through which the water freely flowed. This, as well as the main stream between the junction and Hammond, has, within recent years, been dredged, and small steamers now daily ply between Chicago and Hammond.

Throughout the full length of its course in Lake County and in Porter County west of Chesterton, the waters of this strange stream have, in the summer season, but little perceptible flow. In places they spread out a half mile or more wide, and the channel is so clogged with the leaves of the water lily and other aquatic plants that a boat can scarcely be forced along. "But in the late winter or early spring-

time, when the melting snow and heavy rainfalls fill to the brim the low banks, the overflow covers a large amount of surface, justifying the expression of the early geographers that 'the country around the extreme south bay of Lake Michigan has the appearance of the sea marshes of Louisiana.'"^{*} It is then that the marshes of the Calumet become the temporary home of thousands of water-fowl and the paradise of sportsmen.

II. THE MORAINIC OR MIDDLE REGION.

This region comprises, approximately, 485 square miles lying across the center of the two counties. It is covered by a sheet of drift which at Crown Point is 141 feet and at Valparaiso 125 feet in thickness. The upper portion of this drift is, as already noted, a part of the great Valparaiso moraine, the origin and general trend of which has been given. Where this moraine crosses the State line and enters Lake County it is about 17 miles in width, extending from near Dyer to a point opposite Sherburnville, Illinois. The greatest height or main crest on this line is southwest of the town of Brunswick, in section 36 (34 north, 10 west.) A weaker crest line which forms the watershed in western Lake County runs parallel with the inner border of the moraine from near Orland, in Cook County, Illinois, southeastward, entering the State of Indiana about six miles north of the main crest line, section 36 (35 north, 10 west.) The surface in this vicinity and for some miles north and northeast of St. John's is more broken and irregular than farther southward. The soil immediately overlies a thick bed of clay, in which are mingled many pebbles and small bowlders. In northern Hanover Township the surface is undulatory, but not broken by deep ravines. Farther south a high, rolling prairie region sets in, which covers the southern part of Hanover and the northern two-thirds of West Creek townships. The soil of this prairie, as that of several to the eastward, is a rich, black loam, which covers to a depth of from one to three feet the clay till of the moraine. This clay varies in thickness from 40 to 65 feet. Beneath it is a sand stratum from 20 to 70 feet thick, which furnishes plentiful water.

The main crest of the moraine passes along a wooded ridge about a quarter of a mile north of Cedar Lake and thence along a low, curving ridge to the fair ground south of Crown Point. Between this city and Cedar Lake and extending southward almost to Lowell is a wooded table-land, in places quite broken, where the clay of the mo-

^{*} Ball, Rev. T. H.—Lake County, 1884, 178.

rairie comes close to the surface. East of this wooded belt the rich rolling prairies again set in and cover the greater portion of the morainic area embraced in the eastern third of Cedar Creek and the western half of Eagle Creek townships.

North of Le Roy, in sections 1 and 12 (34 north, 8 west), the crest of the moraine is cut by a branch of Deep River flowing northward. In this region the Lake Michigan watershed extends farther southward than at any other point in Indiana. According to the report of the United States Deep Waterways Commission for 1896, the crest of the moraine at the lowest point near the head waters of Deep River and Eagle Creek is 747 feet above tide, or 165 feet above the waters of Lake Michigan. Just south of the divide, in Le Roy, is a flowing well which furnishes a plentiful supply of good water. The bore was sunk through clay to a depth of 65 feet, when a water-bearing stratum of sand was encountered.

In the Court House yard at Crown Point the surface is 714 feet above tide. At this level a bore was begun in 1889 and put down to a depth of 3,100 feet in search of gas. No accurate record of the formations passed through was kept, but, from a partial record and samples of drillings shown me by Mr. W. A. Clark, the following section was made:

SECTION OF DEEP BORE AT CROWN POINT.

1. Drift.	{ Soil and clay	15 feet.
	{ Sand	100 feet.
	{ Blue clay	25 feet.
2.	Genesee shale	112 feet.
3.	Lower Helderberg and Niagara limestones.....	433 feet.
4.	Niagara shale—bluish green	55 feet.
5.	Clinton limestone	57 feet.
6.	Hudson River shale—bluish green.....	122 feet.
7.	Trenton limestone	556 feet.
8.	Sandstone, alternating from brown to white.....	1,625 feet.
Total		3,100 feet.

The upper two-thirds of the Trenton limestone, struck at 919 feet, was darker brown than the lower third, the latter being whitish, with streaks of pure white sand scattered through it. The bore filled with salt water from the Trenton to within 100 feet of the top.

The water supply of Crown Point is derived from the stratum of sand which immediately underlies the surface clay. At the water works, in the north part of the city, are two eight-inch wells located but 12 feet apart, which furnish an average supply of 200 gallons a minute, and can furnish 400 gallons in an emergency. The soil and

clay at this point are 40 feet thick and the wells penetrated the underlying sand to a depth of 20 feet. The water is "hard," containing lime and iron salts, and has a tendency to encrust the pipes through which it flows. For drinking purposes and household use its quality is excellent.

The northern slope of the morainic region is in Lake County much more narrow and abrupt than the southern. It contains several small prairies, and in the eastern portions of Winfield and Ross townships a number of low ridges or gently undulating swells, with intervening sags. In general, especially on the prairie, the soil is a rich black loam, but on some of the ridges mentioned it is a whitish clay.

On the whole, it may be said that the surface of the moraine in Lake County is much less rugged and irregular than in Porter. The large boulders, usually accompanying such a moraine, are far less numerous in the former county. But one or two were seen which were more than 18 inches in diameter. Even the smaller ones were scarce and in most places have been carefully gathered for use in the foundations of buildings.

The general trend of the morainic belt in Porter County is to the northeast. Where it enters the county it is about 15 miles in width, extending from section 10 (35 north, 7 west), about two miles north of the town of Woodvale, to the southwest corner of section 22 (33 north, 7 west), two miles southwest of Hebron. At the latter town its surface is about 48 feet above that of the Kankakee marsh lands, three miles to the southward. The crest of the moraine crosses the county line a little south of the common corner of the four townships of Ross, Winfield, Porter and Union. Thence it extends a little north of east to a point about a mile east of Valparaiso, where it is cut by Salt Creek flowing northward. Beyond this stream it extends from Emmetsburg in a northerly direction to Liberty Township, where it trends to the east and passing across the southern tier of sections of Jackson Township enters Laporte County.

North of Emmetsburg, in section 11 (35 north, 6 west), the height of the moraine, as determined by Leverett, is approximately 840 feet, and near the center of section 30 (36 north, 5 west), Mr. Henry Rankin has run a level which showed the surface to be 306 feet above Lake Michigan, or 888 feet above tide. This latter point is probably the extreme height to which it reaches in the two counties.

The topography of the morainic belt of Porter County is much more varied than in Lake. Immediately north and west of Hebron are a number of high wooded ridges composed of clay and covered

for the most part with timber. Horse Prairie, a higher undulatory region, then sets in and covers the greater portion of the south half of Porter Township. Boulders of large size begin to appear. The following section of an open well sunk on the land of Hon. Geo. C. Gregg, east half of section 34 (34 north, 7 west), two miles north of Hebron, was furnished by Mr. Gregg, and will give an idea of the morainic material in that vicinity:

SECTION OF WELL NORTH OF HEBRON.

1. Soil and stiff yellowish clay	12 feet.
2. Blue clay—comparatively free from pebbles.....	17 feet.
3. Sand, similar to that in ridges to the northward....	18 feet.
4. Hard, sticky blue clay with flint pebbles.....	20 feet.
5. Coarse blackish sand.....	4 feet.
Total	71 feet.

Plenty of good water was found in the blackish sand. It was necessary to curb the upper stratum of sand, No. 3 of the section, as it caved in very badly. The total thickness of the drift at Hebron, on a level, probably 30 feet below this point, was found to be 108 feet.

North of Horse Prairie, in sections 13, 14 and 15 (34 north, 7 west), a stiff, clayey subsoil comes near the surface, and a timbered area begins which covers the northern half of Porter and the southern half of Union townships. This area is much broken, especially along the crest of the moraine. The soil over much of it is a whitish clay, which produces fair timothy hay, but poor crops otherwise.

The northern half of Union Township is in part covered with a sandy soil. This starts in about sections 23 and 24 (35 north, 7 west), and extends to the Grand Trunk Railway or to the border of the moraine. A spur of the moraine about two miles wide extends into Portage Township to the southeastern corner of section 13, and embraces a portion of Twenty Mile Prairie.

In the western half of Center Township the moraine begins to show more prominently, there being many high ridges which intersect one another at various angles. Their component materials, where exposed, are mainly a stiff yellow clay, with many limestone pebbles which are angular and but little water-worn. In several places occur deposits of gravel a few feet in thickness, but in general it is too fine to make good road material. The city of Valparaiso is located on the slope of one of these subordinate ridges southeast of the main crest of the moraine. The level at the station of the Grand Trunk Railway, in the northern part of the city, is 820 feet; that of the Court House yard 803 feet, and that of the Pennsylvania road, in the southern part of the city, 736 feet above tide.

At a still lower level—718 feet—in the southwestern part of the city, a deep bore was put down for gas in 1889. From data and specimens of drillings kindly shown the writer by Mr. C. W. Dickover, the following strata were shown to have been pierced:

SECTION OF DEEP BORE AT VALPARAISO.

1. Soil and drift	125 feet.
2. Genesee shale	65 feet.
3. Corniferous and Lower Helderberg.....	230 feet.
4. Niagara limestone	270 feet.
5. Niagara shale	5 feet.
6. Clinton limestone—white to steel gray.....	55 feet.
7. Hudson River limestone.....	110 feet.
8. Hudson River shale—bluish green.....	160 feet.
9. Trenton limestone*	330 feet.

Total1,350 feet.

At a depth of 1,290 feet salt water was struck, which rose to the top of the well.

In Liberty Township the northern slope of the moraine is much more narrow and abrupt than in any part of its course in the two counties. From the road a mile or two east of Gosset's mill one gets, looking across a branch of Salt Creek to the south and southwest, a fine view of the morainic hills, since they are from 100 to 150 feet above the level of the observer. To the northeastward the irregularities of the surface become more pronounced, and in Jackson Township, especially in sections 13, 14 and 15, many of the features of a typical, unmodified terminal moraine are present. Here is found an intricate series of subordinate ridges putting out in every direction from the main one. Boulders are very plentiful and in several places were noted to be sole material used in the construction of fences. The largest ones seen in the two counties were in this vicinity. There are also numerous large rounded depressions, some of them embracing an acre or more in extent, which recall vividly the sinkholes of southern Indiana. Alternating with these are corresponding rounded knobs or knolls, the crests of which, in a number of instances, are 80 feet or more above the bottom of the depressions. These "knobs and basins," as they are called, owe their peculiar formation to the irregular deposition of the glacial debris, there probably having been a great isolated mass of ice imbedded in the debris where each basin

*The upper 280 feet of this stratum was somewhat darker colored than the lower 50 feet, and had been called by Mr. Dickover "Galena limestone." This is only a synonym for the upper or later portions of the Trenton formation, which in Illinois and Wisconsin are lead bearing.

now exists. By its melting a cavity was left which was separated by a mass of drift material from a somewhat similar cavity where another ice mass had been imbedded. The shape and size of each cavity or basin depends upon the shape and size of the ice block and the amount of drift originally covering it. Where an impervious bed of clay was left or has accumulated in the bottom of the "basin," the latter often fills with water and a small lake results. Such was doubtless the origin of Bull's Eye Lake, two miles north of Valparaiso, whose area is but one-half acre, and whose waters are 45 feet in depth.

The northern border of the morainic belt extends diagonally across Liberty Township from its southwestern to its northeastern corners. Thence it passes through sections 6 and 5 in the southeastern corner of Westchester Township. Bending to the east, then south and again east, it follows closely the border line between Pine and Jackson townships. Turning north along the county line, it finally leaves the county from the east side of section 36 (37 north, 5 west.)

Just within the borders of the moraine, on the southeast quarter of section 1 (36 north, 5 west), is a flowing well which was put down in June, 1897. Its section, as furnished by the owner, Edward Stevens, shows the following strata:

1. Soil and gravel 3 feet.
2. Blue clay60 feet.
3. Sand21 feet.

On September 10th the water was rising through a two-inch pipe to a height of four feet above the surface. Through a three-quarter-inch pipe it had risen 25 feet above the surface, but had failed to rise to the top of an additional pipe 18 feet in length and of the same diameter. The rate of flow was about six gallons per minute. The source of this water is probably on the slope of the moraine to the southward.

North of the border of the morainic region proper, as traced above, there exists in Porter County a long, narrow ridge, whose surface is a till of clay. This ridge lies north of the Calumet River and extends east and west through Westchester and Pine townships. Its average width is about a mile. The surface is quite regular except where cut by erosion. The soil is a whitish clay, well adapted to the production of timothy hay, but producing poor crops of the cereals. This ridge, like the one west of Hobart, was an island whose surface lay above the waters of the shallow bay of Lake Chicago, which covered and modified the area between it and the morainic region to the south.

The southern margin of the morainic belt in Porter County extends from a point almost a mile south of Hebron in a northeasterly direc-



Looking west across the lake. Ice houses on opposite shore.



A camp on the west shore.

VIEWS OF CEDAR LAKE.

tion, crossing the southeastern corner of Porter Township and passing diagonally across Morgan and the southeastern corner of Washington townships. The southern slope is much more subdued or less broken and irregular than the northern. The soil is usually a whitish clay and far less rich and productive than that of Morgan Prairie, which borders a large portion of this region on the east.

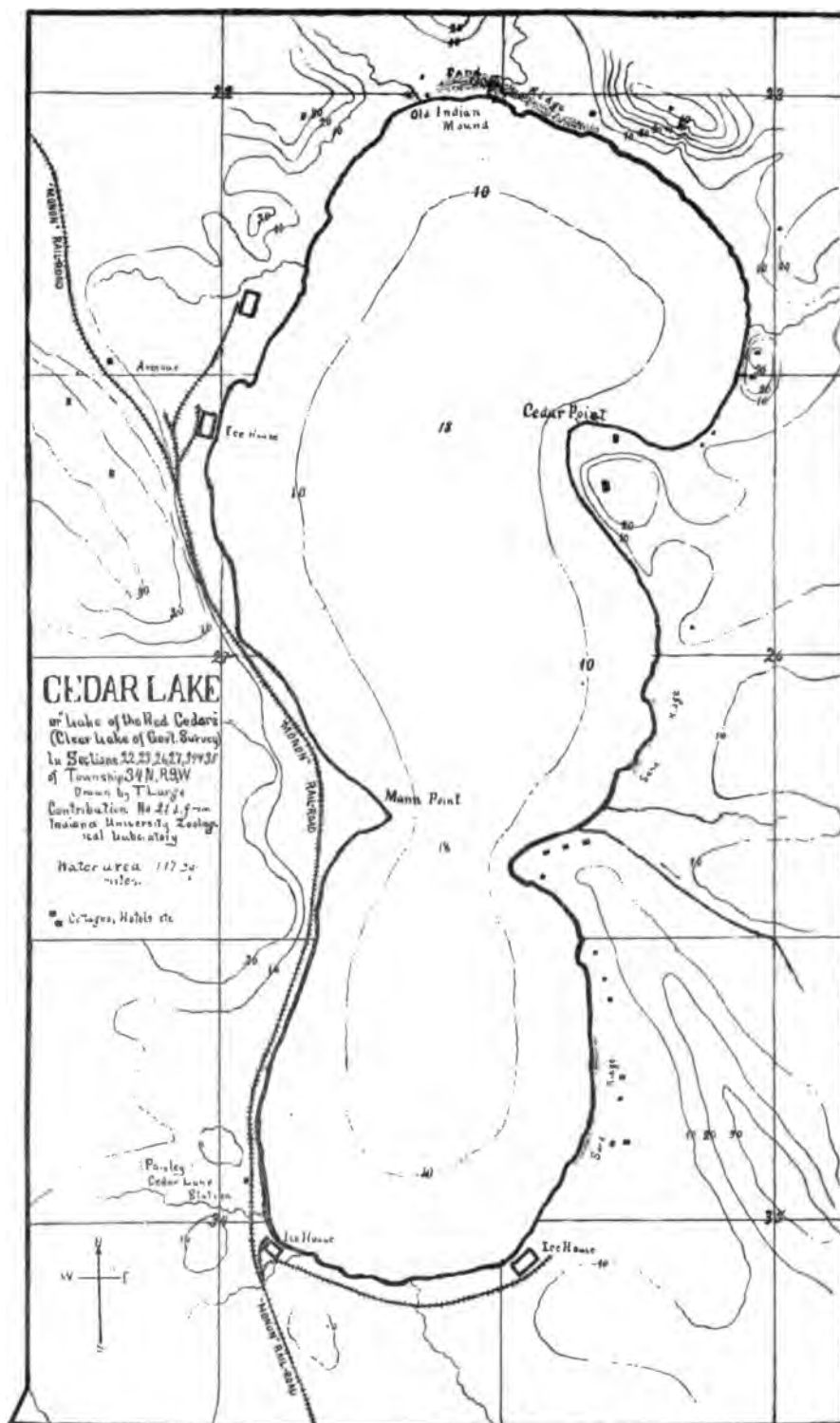
With the exception of Lakes Wolf and George, in the northwestern corner of Lake County, which, as already noted,* are but remnants of a once shallow bay of Lake Michigan, the lakes of the two counties are of morainic origin and should be treated in this connection. Those which the citizens have esteemed large enough to be worthy of names are Cedar Lake and Fancher Lake, in Lake County, and Eliza, Quinn, Flint, Long, Bull's Eye and Clear lakes, in Porter County. It is a noteworthy fact that each of these lies very close to the summit of the main crest of the moraine.

The largest, most handsome and best known of these lakes is Cedar Lake, or "Lake of the Red Cedars," located in parts of sections 22, 23, 26, 27, 34 and 35 (34 north, 9 west), on the line between Center and Hanover townships, about four miles southwest of Crown Point. Its general outline somewhat resembles that of a kidney. Its length is about two and one-eighth miles and its greatest breadth a little more than three-quarters of a mile. Its water area, as computed by Thomas Large,† is at present about 1.17 square miles.

Cedar Lake owes its origin to the irregular deposition of the surrounding drift. On all sides, except the south, it is embraced by wooded ridges of sand or clay, those to the north rising 60 feet above the level of its waters. Between these ridges, on the southern slope of the moraine, a long, low valley was left by the retreating ice sheet. The bottom of this valley was covered with an impervious stratum of clay. In its depression collected the waters of the melting glacier and the lake resulted. Its waters once covered all the low, marshy land to the southward and overflowed the lowest part of the rim of its basin toward the Kankakee. At that time they covered the present shores as far as the foot of the ridges on the east and north and were probably 40 feet deep in places. Now they nowhere exceed 20 feet in depth. Within the memory of man they have receded from 50 to 90 feet from the former margins. This recession and consequent lowering of depth is mainly due to three causes, viz.:

* P. 37. Fish Lake, in the extreme northeastern corner of Porter County, is a wet weather lake which is practically dry in summer.

† See Proc. Ind. Acad. Sci., 1896, 299 and 301. The accompanying map of Cedar Lake was also drawn by Mr. Large and published in the Proc. of the Academy, *loc. cit.* By permission it is reproduced in this connection.





GLIMPSES OF CEDAR LAKE.

a. *Artificial Drainage.* To reclaim 200 acres of comparatively worthless marsh land—at its southern end—a ditch was cut on its eastern side which lowered the level of the water from 8 to 12 feet. This outlet is the present source of Cedar Creek, which flows southward through the town of Lowell and empties into the Singleton ditch.

b. *The Growth and Decay of Aquatic Vegetation.* Beneath the shallow water along its western and southern margins there are thick beds of muck and black mud. In these beds grow luxuriantly spatter-dock, rushes, ditch moss, algae and many other aquatic plants. These die down and the matter which they have withdrawn from the air and solidified within their stems is added to the surface of the muck. The latter is, therefore, ever thickening and encroaching upon the water area.

c. *Decrease of Water Supply.* Situated, as it is, so near the crest of the moraine, the area from which the lake draws its supply of water is very limited, being but a few square miles in extent. This supply comes wholly from the rain of the season, which, soaking into the earth, finds its way through springs into the immediate basin of the lake. Since the settlement of the surrounding region much timber has been cut away and the land so drained that the water flows rapidly away instead of soaking into the ground and finding its way into the lake as formerly. At present the season's evaporation is, probably, almost as great as the supply. For these causes the area and depth of the lake have for years been slowly diminishing and will continue to diminish until it wholly disappears.

Within the past ten years many cottages have been erected on the wooded ridges about Cedar Lake. The Monon Railway, which runs along its western border, has possessed itself of the high wooded ridge on that side and has transformed it into a so-called park. Thousands of visitors are each season brought from Chicago and from the cities to the southward. The quiet beauty and repose which for centuries existed along the margins of the lake have forever disappeared. In their stead have sprung up those artificial surroundings which the ever-increasing wants of the Nineteenth Century seeker after pleasure demand and eventually secure.

Fancher Lake is located in the Lake County fair grounds, northwest quarter of section 17 (34 north, 8 west), one mile south of Crown Point. It covers about 20 acres and in places is said to be 35 feet in depth. Lying on the very crest of the moraine, it doubtless occupies a kettle hole or basin formed by the melting of an imbedded ice mass. Its waters flow northward, finding their way into Lake Michigan by the way of Deep River and the Calumet.

Lakes Quinn and Eliza are located about a mile apart, in sections 12 and 1, respectively (34 north, 7 west), near the northern line of Porter Township, Porter County. The former covers an area of about 12 and the latter 40 acres. Eliza is but one-half mile south of the divide and is much the more handsome, being surrounded on all sides by oak groves. Wolf Creek is the outlet of both lakes, flowing southward from Eliza through Quinn, and then southeasterly into Sandy Hook Creek.

Lying three and one-quarter miles a little east of north of Valparaiso and about a mile east of the crest of the moraine is Flint Lake. Its waters cover an area of 95 acres and have an average depth of about forty feet. It is surrounded by high ridges, those on the east and north being wooded. Its western and a portion of its southern margins, like those of Cedar Lake, have mucky banks, while those of the east and north are sandy, a condition due to the prevailing westerly and southerly winds, which create a breaking of the waves along the eastern and northern shores, and so prevent the formation of muck.

The waters of Flint Lake have receded more than 50 feet from the edges of their former margins. This recession is due to the same causes as have brought about that of Cedar Lake. Flint Lake, however, is the source of the water supply for the city of Valparaiso, 600,000 gallons being at present drawn from it each day. Its artificial drainage is, therefore, somewhat excusable. It lies 243 feet above Lake Michigan and 14 feet above the Court House yard at Valparaiso, its waters being brought to that city by both gravity and direct pressure. If the lake continues to recede at the present rate it is only a question of a few years until the city will have to seek another water supply.

Long Lake occupies a narrow morainic valley a short distance northwest of Flint Lake. It is about three-fourths of a mile in length by 40 rods in greatest breadth, and is connected with Flint Lake by a small drain. The natural outlet of both is one of the branches of Crooked Creek, a tributary of the Kankakee.

Clear Lake is located partly in section 24, Jackson Township, and is cut by the line between Porter and Laporte counties. It has no outlet and its waters are 25 feet in average depth, and cover an area of about 30 acres. In the words of Dr Chas. R. Dryer,* all of these morainic lakes in Indiana "are geologically young, being confined to the very latest moraines of the glacial period. They are mere babes born yesterday and destined to die to-morrow. The present dominant race of men may pass away and leave these lakes still lying like bright jewels among the hills: but every one is doomed to final extinction.

*Stud. in Ind. Geog., 1897, 59.

‘The hills are shadows and they flow
 From form to form, and nothing stands:
 They melt like mist, the solid lands,
 Like clouds they shape themselves and go.’

But of all features of the landscape, lakes are the most ephemeral. As long as they remain they will continue to contribute to the service and delight of man. They fed the savage with fish, but they feed the more highly developed man with beauty, and afford means for that relaxation and healthful pleasure which the conditions of modern life demand.”

The drainage system of Lake and Porter counties is governed almost entirely by the topography of the surface of the morainic region. The watershed or divide separating the basin of Lake Michigan from that of the Mississippi corresponds very closely to the crest line of the moraine already traced. With two exceptions, all streams which start south of that crest line find their way into the Kankakee, while all but one of those starting north of it flow into Lake Michigan. The exceptions noted are the branch of Deep River rising near Le Roy, which has been mentioned as cutting the crest east of Crown Point; and a branch of Salt Creek, which has its source in Bull’s Eye Lake, north of Valparaiso, and flowing southward and then westward around that city, unites with another branch which rises in the northern part of Morgan Township, and cuts the crest south of Emmettsburg. West Creek, rising near St. John’s, flows southward, cutting the main crest between Hanover and Brunswick.

Just north of Cedar Lake, in section 23 (34 north, 9 west), is one of the best marked portions of the watershed in the two counties. A narrow ridge, not over three rods wide and six to eight feet in height, separates for a distance of 150 feet a marsh on the north from the head of a shallow ravine on the south. The waters of the marsh, which is fed by springs, flow, eventually, into Lake Michigan, while those from the ravine find their way, after many wanderings, into the Gulf of Mexico. The divide is also very narrow in Union Township, Porter County, just north of Lake Eliza, and again in section 34, in the south half of Jackson Township, between the head waters of Coffee and Crooked creeks.

Aside from the Calumet and Kankakee rivers, all the principal streams which drain the two counties have their sources on or near the crest of the divide. These are, in Lake County, West Creek, rising near St. John’s and flowing southward through Hanover and West Creek townships; Cedar Creek, the outlet of Cedar Lake, flowing southward through Cedar Creek Township, and

Eagle Creek, the outlet of a small lake northeast of Le Roy and flowing south. The waters of these three are collected by the Singleton ditch in the Kankakee basin.

On the north of the divide one of the branches of Deep River has its sources in Fancher's Lake and in a marsh two miles northwest of Crown Point. This unites in the northeastern corner of Center Township with the branch from near Le Roy, and flows northeasterly to the county line about a mile southeast of Woodvale. Thence it bears northwest to the mouth of Turkey Creek, in section 1 (35 north, 8 west); thence northeasterly through Hobart to near the station of Lake, where it again turns west and empties into the Calumet, in section 14 (36 north, 8 west). Throughout its course from Woodvale northward it is a slow flowing, sluggish stream, with its bottom of clay or mud. In its waters the fresh water mussel, *Anodonta grandis* Say, and allied mud-burrowing species exist in enormous numbers, while in the mill ponds at Woodvale and Hobart great masses of aquatic vegetation spring up and during the hot days of August and September decay and throw off a disagreeable odor. Since 1883 the amount of water at Woodvale has been sufficient only to run a corn mill, and all wheat has been ground by steam.

In Porter County the streams south of the divide are Sandy Hook and Crooked creeks, both of which are of small size and sluggish in flow. The former has for its tributaries Wolf Creek, the outlet of Eliza and Quinn lakes, and the West Branch of Sandy Hook. These drain Porter and the west half of Morgan townships. Two branches of Crooked Creek rise near the divide in the south part of Jackson Township, and a third is the outlet of Flint Lake. This stream drains Washington and the east half of Morgan townships and empties into Reeve's ditch in the Kankakee marshland.

North of the divide are Salt Creek and Coffee Creek, the former being the larger and more important of the two, draining eastern Union and Portage, a part of northern Morgan, all of Center and most of Liberty townships, and emptying into the Calumet, in section 31 (37 north, 6 west). Its waters are sufficient in amount to furnish power for three mills, one just south of Valparaiso, another (Pierce's) in section 16 (35 north, 6 west), and a third (Gossett's) in section 21 (36 north, 6 west). Above each of these the stream widens into a large mill pond, that at Gossett's being a mile long and a quarter of a mile wide. Coffee Creek rises on the crest of the divide in the south half of Jackson Township, and, flowing west of north, drains southwestern Jackson, northeastern Liberty and a part of Westchester townships, emptying into the Calumet a little north of Chesterton. Its current

in Jackson Township is more rapid than that of any other stream in the counties, and at Long's mill, in section 20 (36 north, 5 west) the supply of water is sufficient to turn a large turbine wheel the year round. Several small tributaries of the Calumet drain the northern half of Jackson Township.

III. KANKAKEE OR SOUTHERN REGION.

All that area of the two counties lying south and southeast of the southern border of the Valparaiso moraine is comprised in this region. In Lake County this morainic border extends to the old northern shore line of the Kankakee Marsh and the area south of that line was, at one time, all overflowed or swamp land. In Porter County, about 65 square miles of swamp land proper and 40 square miles of prairie are included within the region under consideration. The prairie portion lies 10 to 40 feet above the level of the main marsh and slopes gently down to it. Along Sandy Hook and Crooked creeks a strip of marsh land, in places two miles in width, extends a number of miles northward into the prairie region, and the difference in level between the two is more abrupt.

The Kankakee River, which forms the southern boundary of the two counties, is noted for its low banks, its sluggish current and the crookedness of its channel. From its source in a large marsh about three miles southwest of South Bend, St. Joseph County, section 16 (37 north, 2 east), it flows in a southwesterly direction through that county to the Laporte County line, from which point it forms the boundary between the counties of Laporte, Porter and Lake on the north and St. Joseph, Starke, Jasper and Newton on the south. Crossing the State line near the southwestern corner of section 1 (31 north, 10 west), it flows a little south of west to Kankakee, Illinois, where it receives the Iroquois River from the south. Thence it flows almost due northwesterly to near the northeastern corner of Grundy County, where it unites with the Des Plaines, the two forming the Illinois River.

Between its source and the point where it crosses the State line, in the extreme southwestern corner of Lake County, the distance is about 75 miles. Within this distance the stream is said to make 2,000 bends and to flow over a total length of 240 miles. According to the survey made by Dr. J. L. Campbell, in 1882, the difference in level between the source and the State line is but 97.3 feet, showing a fall of but 1.3 feet to the mile. For this reason its waters, above the crossing of the Monon Railway, section 33 (32 north, 8 west), have an almost imperceptible flow, and in many places wild rice, rushes, lily pads and

aquatic grasses so choke the channel as to cause the flooding of the marshes during a summer freshet. Between the Monon Railway and the State line the velocity of the flow is greater, owing to a slightly increased slope and fewer bends.

In Indiana the bed of the Kankakee is composed mainly of sand and fine gravel. But in a few places, as just west of Dunn's bridge, in the southeastern corner of Porter County, it contains rather extensive beds of coarse gravel. Only at one point, where visited by the writer, was stone seen in its bed. This was just across the State line in Illinois, where, in front of the residence of Daniel Parmlee, the current is more rapid than elsewhere noted, and a number of large bowlders are located near the middle of the channel.

The amount of water which the river now discharges varies with the season much more than formerly. According to measurements made by Dr. Campbell* in August, 1882: "The sectional area at the State line was 543 square feet, the mean hydraulic depth 4.5 feet, the calculated mean velocity 2.35 feet per second, and the volume of discharge 1,271 cubic feet per second." This was during an average low-water stage of the river. The least flow is during extreme cold weather, when the great marsh, which borders the river, and which acts as a sort of reservoir or feeder, is frozen solid. In 1882 there were almost 500,000 acres of this marsh land within the valley of the Kankakee. It resembled an immense sponge, slowly absorbing the water during the wet season and as slowly oozing it forth during the dry, so that the flow throughout the year was quite regular and uniform in amount. At present, on account of the drainage of a large portion of this marsh, especially in St. Joseph, Starke and Laporte counties, the water flows off much sooner after it falls and consequently the river is higher during the autumn and spring floods and lower at other seasons than formerly. From careful measurements made for a series of 12 years at Wilmington, Illinois, it was found that the average volume carried by the Kankakee during the extreme high water was 30,000 cubic feet per second.† Since the partial drainage of the upper portion of the marsh there is little doubt but that during the spring floods the discharge across the State line is fully 25,000 cubic feet per second.

In 1872 Rev. T. H. Ball, of Crown Point, wrote of that portion of the Kankakee bordering on Lake County: "A river is known to be there. The blue line of trees marking its course can be discerned from the prairie heights; but only occasionally in midwinter or in a

* Rep. Upon Improv. Kank. River, 1882, 16.

† See Leverett.—Ann. Rep. U. S. Geol. Surv., XVII, 1896, 740.

time of great drought can one come near its water channel. So far as any ordinary access to it from this county is concerned, it is like a fabulous river, or one the existence of which we take on trust."* Now, within Lake County, five north and south roads reach its borders through the marshes, while three wagon and two railway bridges span its waters. In Porter County six roads lead to it, and one railway and three wagon bridges cross it.

The Kankakee marshes comprise the most extensive body of swamp land in Indiana. The original area of this marsh land in the seven counties drained by the Kankakee was, as already noted, almost a half million acres. For many years schemes of various kinds have been proposed, and hundreds of thousands of dollars have been spent, in endeavoring to reclaim a portion or all of these lands. State aid has been invoked and a large sum appropriated and expended in removing a rock ledge at Momence, Illinois, but this was only a beginning, and, as yet, the end is not in sight. In Lake County there exists, at the present time, 50,000, and in Porter County about 40,000 acres, which, for at least four months of the year, are covered with from one to five feet of water; and during four of the remaining months this area is an immense bog or quagmire.

*The
Kankakee
Marshes.*

In these two counties the marshes occupy a broad valley between the border of the moraine and the channel of the river. The mean elevation of this valley is 90 feet above the level of Lake Michigan and 160 feet above the waters of the Wabash River at Lafayette, Indiana. The surface of this marsh land is, for the most part, a great treeless plain, with an average slope of about 1.2 feet to the mile in a westerly direction. On the immediate border of the river there is a strip ranging in width from a fourth to one and one-half miles, which is heavily timbered. In the southeastern corner of Lake and on adjacent territory in Porter County this timbered area widens and comprises about ten square miles. The only other timber is found on the so-called "islands" or "groves," whose surfaces rise 10 to 20 feet above the general level of the marsh. The largest of these in Lake County is Fuller's Grove, in sections 4 and 5 (32 north, 8 west), between the Griesel and Singleton ditches. It is one and a half miles long by one-third of a mile in width. Others are Oak Grove, south half of section 16 (32 north, 9 west), and South Island, in sections 13 and 24 (32 north, 8 west), each of which are about one by one-quarter miles in area; Beech Ridge, section 9 (32 north, 7 west); Ridge Island, sections 10 and 11 (32 north, 8 west); Crab-Apple Grove, section 19

* Lake County, 1834-1872, 16.

(32 north, 9 west), and others, are smaller. All were once covered with a heavy growth of oak, hickory, black gum and other timber, the best of which was long ago removed by the early settlers along the northern border of the marsh. The surface of these islands, when cleared, becomes fair grazing lands, but the soil is in general too sandy for cultivation. On the majority of the "islands" are houses, in which dwell the owners or renters of the surrounding marsh lands.

The open marsh is covered with a rank growth of wild grasses, bullrushes, sedges, reeds, wild rice and other semi-aquatic vegetation. Over a large area which has been sufficiently drained much of this

*Vegetation
of the
Marshes.*

growth is annually cut, either for bedding or marsh hay. In other places the surface is either too rough, being cut up with sloughs and bogs, or never dries sufficiently to allow teams to pass over it. Oftentimes, after a long drouth, thousands of acres are burned over by a fire which sweeps along with great rapidity, consuming everything in its path.

Between the woodland bordering the river bank and the marsh, as well as around the margin of most of the islands, there are dense thickets of elbow brush, *Cephalanthus occidentalis* L., willows, swamp dogwoods, soft and red maples and other swamp-loving shrubs. These grow so densely that a person has no little difficulty in forcing his way among them. In some places, as at Stowell's ranch in south-eastern Porter, sections 1 and 2 (32 north, 5 west), and at Gales, in southern Lake, section 26 (32 north, 9 west), large areas of land whose soil is a rich sandy loam rise above the surrounding swamps. These areas were less heavily timbered than the islands above mentioned, and comprise valuable farming lands.

In general the soil of the marsh is a dark, sandy loam, very rich in organic matter. For century upon century a thick mass of vegetation has fallen and decayed, and mingled with its remains have been the particles of sand and clay brought down as sediment by the overflowing

*Soil
of the
Marshes.*

waters. No richer soil occurs in the State, and its depth in many places is from three to five and even six feet. Like all soils composed of similar materials, it is very porous and has the power of taking up and retaining large quantities of water. Beneath the soil is a sand, darker colored and containing a greater mixture of calcareous and earthy matter than that found near the shores of Lake Michigan. When thrown up by the dredge it packs and becomes hard, forming excellent road-beds wherever it has been put to that use. Below the sand are layers of fine gravel and below that the omnipresent blue clay of the older glacial tills lies next above the surface rock.

All of the materials lying between the blue clay and the soil are the sedimentary deposits of a great post-glacial river, for the valley itself doubtless owes its origin to the flow of waters which followed the melting of one of the later retreating ice sheets. This flow was at

*Origin of
Kankakee
Valley.*

first sufficient in volume and velocity to erode the present valley to quite a depth through the underlying clay. Later, on account of a diminution in the supply of water, as well as the gentleness of the slope, the current became too sluggish to erode much deeper or to carry coarse material, and only the finer sediment was brought down. From a still farther diminution in the water supply, as well as by the building up of a sedimentary dam near the western end of the valley, the water for a long period ceased to flow, and a lake of shallow depth resulted. Where the waves or currents of this lake washed against the higher portions of its bed, or its shores, accumulations of sand and mud were thrown up from its bottom. These increased in size, and, rising above the water, became covered with trees. The surface of these "sand islands" has ever since remained above the flow of waters and, as a consequence, their soil lacks those rich organic constituents, formed by the decay of aquatic plants, which are possessed by the soils of the surrounding marsh.

Again, by a new accession of water from the northwest, the barrier at the foot of the valley was washed away and the river of the present had its beginning.* At first its waters flowed the full width of the valley, but in time their volume decreased and a portion of the river's bed became bare in summer. Over this a vegetation sprang up and decayed. A soil was started above the sands and was added to each year by the decay of the summer's vegetation and the sediment brought down by the overflow in spring. The main current of the stream was thus gradually narrowed until it reached its present size. The annual overflow is yet sufficient to cover the porous soil and to fill its every interstice with water, which, on account of the gentle slope, cannot flow rapidly away after the subsidence of the flood. Thus the valley remains a marsh, and will so remain until a complete system of drainage furnishes a more rapid outlet for the waters which are absorbed during the annual overflow.

Quite a percentage of the marsh land in the two counties has been already partially reclaimed by large ditches either dredged by private enterprise or by assessment against the adjacent lands. In Porter County the largest of these is Reeve's ditch, beginning on the county

*This alternate increase and decrease in the volume of the water may have corresponded in time with the increase and decrease in the waters of Lake Chicago, already noted.

line, in the southeast quarter of section 24 (33 north, 5 west.) Thence it runs southwestward across section 25 and then due west to Grand Junction, east half of section 36 (32 north, 6 west), where the old

*Drainage
of the
Marshes.*

mouth of Crooked Creek unites with the Kankakee. A mistake was made in the construction of this, as in several other of the large ditches, in that the sides were left almost perpendicular instead of with at least a 45 deg. slope. As a result, freezing has caused the sides to slough off and partially fill the ditch, so that it only serves as a drain in wet weather.

In Lake County the Singleton ditch is the main one, the others being tributary to it. This ditch extends from Eagle Creek, in section 29 (33 north, 7 west), in a generally southwesterly direction to the river, crossing the State line near the southwest quarter of section 25 (32 north, 10 west). It was begun in 1882 and completed in 1886; being constructed under the general ditching laws, with an average assessment of about \$2.00 per acre on all lands between the river and the north margin of the marsh. It was 20 feet in width by 5½ feet to 7 feet in depth, but its sides were too abrupt, and it now needs re-dredging throughout its full length. By its construction a large acreage of the marsh was reclaimed sufficiently for the cutting of wild hay. Along the northern border minor secondary ditches soon allowed the raising of cereals on a strip a mile or two wide.

The Brown ditch was constructed in 1888, mainly as a shore ditch to prevent the spreading of water from the river northward. Through it the water flows in all seasons, even in great drouths. In length it is about 14 miles, extending from section 4 (32 north, 7 west), to the Singleton ditch, near the west end of Ash Grove, section 29 (32 north, 9 west). Other subordinate ditches are Griesel's and Ackerman's, shown on the accompanying map.

The report of Dr. J. L. Campbell on the drainage of the Kankakee marshes, published in 1882, has become very scarce. It is thought best, therefore, to incorporate in this connection the conclusions and recommendations of Dr. Campbell relative to the draining of those portions of the marsh lands lying in Porter and Lake counties. These conclusions were based on an accurate survey of the entire region, made by authority of an act of the Legislature, approved April 11, 1881. Under the head of "General Improvement," Dr. Campbell says:* "The drainage and recovery of the Kankakee marshes will in-

*"Report Upon the Improvement of the Kankakee River and the Drainage of the Marsh Lands in Indiana," 1882, 15.

*Campbell's
Report
on the
Drainage
of the
Kankakee
Marshes.*

clude: First, the construction of a better main channel than now exists, for the flow of the river; second, the straightening and deepening of the beds of the streams which empty into the main stream; and third, the digging of a large number of lateral ditches through the swamps to the improved channels.

"The portion of the work which seems properly to belong to State and National supervision is the improvement of the main channel of the river. The other parts of the work may be left to the owners of the land, to be executed under our general drainage laws."

For convenience in describing the necessary improvements, the river and marsh lands were divided into seven divisions. Of these, the conclusions regarding divisions III., V. and VI. are those which are quoted, since they deal with the drainage of the lands in Porter and Lake counties.*

"DIVISION III. extends from the terminus of Division II. at the mouth of Mill Creek, section 7 (34 north, 2 west), *by a new channel*, to Grand Junction, at the mouth of Crooked Creek, section 36 (33 north, 6 west).

"The Kankakee River below the mouth of Mill Creek has a belt of timber along its banks, which would make the cost of straightening the river very great.

"The great deflection of the river from the general direction of the valley makes it important to shorten the distance by a new channel.

"The line proposed for the improvement lies in a remarkable part of the valley. The line will be clear from timber obstruction, except about one and a half miles at the lower end, where it passes through the belt of river-bank timber into the old channel. The line lies for the most part in a series of deep marshes, now impassable, and well known in the neighborhood as a deep slough, sand channel, etc. The new channel will take the greater part of the water of the improved river above Mill Creek, and all the surface drainage on the north side in Laporte and part of Porter counties. The length of the division will be 21.5 miles.

"The proposed dimensions for the new channel for this division are at the upper end—width of bottom 27 feet, width at top 51 feet, depth 8 feet, area of cross section 312 square feet. At the lower end—width at bottom 33 feet, width at top 57 feet, depth 8 feet, area of cross sec-

* Division IV. was subordinate to III., and included the improvement of Yellow River and the present channel of the Kankakee along the line of Division III., for the purpose of draining the territory south of that river. The estimated cost of this division was \$30,000.

tion 360 square feet. The mean measure will be—width at bottom 30 feet, width at top 54 feet, depth 8 feet, area of cross section 336 square feet.

“These dimensions will give—mean hydraulic depth 5.23 feet, calculated mean velocity 2.405 feet per second, mean volume of discharge 808.4 cubic feet per second. The volume of discharge at the lower end will be 878.4 cubic feet per second.

“The mean dimensions will give—for each linear yard 37 1-3 cubic yards, for each mile 65,707 cubic yards, for the division 21.5 miles, 1,412,700 cubic yards; the cost of which, at 7 cents per yard, will be \$98,889; or, at 10 cents per yard, \$141,270.” But 6.75 miles, or 443,522 cubic yards, of this division lie in Porter County. This, at 7 cents per yard, would cost \$31,046, or, at 10 cents per yard, \$44,352.

“DIVISION V. extends from Grand Junction, section 36 (33 north, 6 west), *by a new channel*, to a point in the river in section 33 (32 north, 8 west), near the bridge on the line of the Indianapolis & Chicago (Monon) Railway.

“At Grand Junction, the new channel or the Upper Kankakee, the old channel or the Yellow River section, and Crooked Creek, unite their waters and form the enlarged lower river.

“From Grand Junction to the State line, and to Momence, Illinois, there is plenty of water for the purposes of navigation, and it is desirable that the improvement below Grand Junction should be made with reference both to drainage and navigation. The route proposed for the new channel will be through the open marsh, entirely free from timber obstruction, except one mile of river-bank timber on the west end, and is admirably located with reference to the drainage of some of the deepest marshes in the entire valley.

“Another route may be adopted, nearly, if not quite, as good as the one proposed, by running the new line more directly west after it enters Newton County, and terminating in the river north of the point above mentioned; thence by the straightened river to the terminus at the State line. The cost of the two routes will be about equal. The length of the division will be 16 miles.

“The dimensions proposed for the new channel for this division are—at the upper end, width at bottom 36 feet, width at top 63 feet, depth 9 feet, area of cross section 445.5 square feet. At the lower end—width at bottom 42 feet, width at top 69 feet, depth 9 feet, area of cross section 499.5 square feet. Mean measure—width at bottom 39 feet, width at top 66 feet, depth 9 feet, area of cross section 472.5 square feet.

"These dimensions will give—mean hydraulic depth 6.06 feet, calculated mean velocity 2.7 feet per second, volume of discharge 1,275.7 cubic feet per second. The volume of discharge at the lower end station will be 1,358.6 cubic feet per second.

"The mean dimensions give for each linear yard 52.5 cubic yards, for each mile 92,400 cubic yards, for the division (16 miles) 1,478,400 cubic yards; the cost of which, at 7 cents per yard, will be \$103,488, or, at 10 cents per yard, \$147,840.

"The old channel of the river below Grand Junction receives no important creek, and only a small expenditure will be required to keep this channel open for its limited drainage area."

"DIVISION VI. extends from the terminus of Division V., along the general line of the river to the State line.

"The increased velocity of the river in this division, owing to its increased slope and the general direction of the stream, make the improvement desirable along the general line of its present flow.

"A new channel in section 33 (32 north, 8 west), one mile in length, and a similar one, chiefly in sections 1 and 2 (31 north, 9 west), two and a half miles long, will be required. The dimensions of these new channels are estimated the same as in Division V.—per mile, 92,400 cubic yards—3½ miles, 323,400 cubic yards; and their cost, at 7 cents per yard, will be \$22,638, or, at 10 cents per yard, \$32,340.

"The other improvements in this division will consist in a general straightening of the channel, the removal of timber obstruction and dredging the channel to secure an additional depth of two feet, the estimated cost of which will be \$69,000.

"The estimated length of the division after the improvement has been made will be 15 miles.

"In addition to the cost of construction, the question of maintenance of the new channel requires consideration. The same causes which produced the present crooked river will, in a less degree, affect the straightened stream, and continued care will be required to preserve an unobstructed flow.

"If we assume that the river now has an approximately stable bed, the result mainly of the free action of natural forces on the sandy soil, it is evident that any increase of velocity will affect this stability and introduce a disturbing element which will require special attention.

"The banks of the new channel will likewise deliver quantities of sand into the current until they assume their proper angle of rest and are protected by grass or other vegetable growth.

"The lateral ditches will also bring down masses of sand, which will, if left uncared for, form bars where these ditches empty into the river.

"To meet these difficulties it will be necessary to keep at work one or two dredging machines until the new channel has assumed a partially stable condition.

"Grass grows most luxuriantly in all parts of the Kankakee Valley, and from this cause we may expect that the banks will be covered very rapidly. After the drainage has been once accomplished and the lands brought under cultivation, there will be a great diminution of the volume of water to be carried off.

"The absorbent power of the reclaimed land and the evaporating surface will be increased, and the quantity of surplus water will be proportionally diminished.

"The diminished volume will give a relative increased capacity, with less depth, and thus by degrees the new channel will become stable, while at the same time it fulfills all the requirements for complete drainage."

The minimum cost of the improvements for draining the Kankakee marsh lands west of the mouth of Mill Creek was thus estimated by Dr. Campbell to be \$294,015, and the maximum \$390,450. Subtracting from these two amounts, respectively, \$67,843 and \$96,918, the estimated necessary cost of that portion of the excavation lying in Laporte County, we have \$226,172 and \$293,532 as the estimated maximum and minimum cost of all improvements between the east line of Porter County and the State line.

From the Porter County line the new channel could be extended eastward to connect with the present river at Lougee's wagon bridge, section 24 (33 north, 4 west), a distance of three miles. Assuming Dr. Campbell's figures of the mean excavation to the mile for Division III. to apply to this extension, its cost would be \$13,798, at 7 cents per cubic yard, or \$19,712, at 10 cents. The total cost of draining the lands would, therefore, according to Dr. Campbell's plans, be between \$239,970 and \$313,244. In addition to the marsh lands north of the river, fully 70,000 acres would be reclaimed in Jasper and Newton counties on the south, so that the cost would be less than \$2.00 per acre for the 160,000 acres in the four counties.

Taking into consideration their proximity to Chicago and the excellence of their soil, there is little doubt but that these lands, if permanently drained, would command from \$40.00 to \$60.00 per acre. It would seem, therefore, that private enterprise would have long since provided for their drainage. But in this instance private enterprise

has been waiting for State aid, which has been granted only to the extent of partially removing the barrier of rock at Momence. If the State would appropriate \$300,000 for straightening the river and reclaiming the lands, it would be only a loan of money, soon to be repaid, for the increase in the taxable value of those lands would soon bring back to her coffers far more than the amount expended. The principal reason why such an appropriation is not made doubtless lies in the fact that the lands are, for the most part, owned in tracts of from one to ten thousand acres, instead of by many individuals. The people of the State do not believe in increasing the wealth of these speculative owners by temporarily taxing themselves. Still, as a business enterprise, the State would, in time, be largely the gainer, and a portion of her area now practically valueless would soon be known as the garden spot of northern Indiana.

GENERAL FEATURES.

Although the prairies of the two counties belong, for the most part, to the morainic region, their consideration has been purposely omitted until after that of the Kankakee marsh, since that marsh is but an embryo prairie; i. e., a prairie now in the course of formation.

We have already noted the fact that the irregular deposition of drift gave rise to the basins of morainic lakes. Where these basins are deep valleys or pot holes, they still contain water. *Prairies.* Where large areas were covered with but a shallow depth of water, those areas were first lakes, then swamps, and finally prairies. The change from one to the other was gradual, and in many places is still going on.

Near the close of the glacial period the surface of the morainic area of Lake and Porter counties contained a number of large shallow basins, which were covered by the melting waters of the glacier. For many, perhaps thousands of years, the waves piled up sands from the deeper portions of these basins into the "sand islands," or present wooded groves, which here and there dot the prairies. Everywhere in the shallow water aquatic plants were slowly decaying, and their organic matter, mingling with the fine sediment which was constantly settling, gave rise to that peculiar soft black mould or loam which forms the main portion of typical prairie soil. After a time, by evaporation and other causes, the water was removed from the surface of each of these shallow lakes, and a swamp resulted. This in turn gave way to a wet prairie, and this to a dry prairie with a compact sod of grasses. As long as the earth was covered with water no seeds of trees

would germinate. Neither would they germinate after the water disappeared, for the soil was too full of humic acid formed by the decaying of the aquatic plants. Finally the sod became so thick and tough that if the conditions of germination had been favorable the rootlets of the sprouting seed could not have penetrated it. These reasons are responsible for the treeless condition of all typical prairies.

In passing back from the margin of the Kankakee marsh lands towards the higher prairies on the moraine, the wet and dry prairies merge by such insensible degrees that it is very difficult at times to fix a point of separation between them. The surface appearances are very much the same. The plants are all herbaceous and belong practically to the same families, differing only in that some prefer dry and others moist situations. The likeness of the soil is still more striking. The same kind of sub-soil is overlain by the same black spongy mould. The "islands" of both marsh and upland prairies are also essentially the same in composition and in the kinds of timber which cover them. No one who carefully compares the characters common to both can for an instant doubt but that the origin of the one has been similar to that of the other.

The greater irregularity of surface in the upland prairie which causes it to be termed *rolling*, is due in part to irregular deposition of drift, the deeper parts of the lakes having been over the lower portions of the present prairie, and in part to the erosion of the waters as they slowly found their way through the countless lagoons of the swamps to lower levels.

In several places in the two counties small prairies have been formed by the work of beavers. Dams were thrown up. Ponds or small lakes were formed, and the sand from the bottom of these lakes was washed out in several localities about their margins. Beaver Dam Marsh, northwest of Crown Point, in section 1 (34 north, 9 west), now in a transition stage between a swamp and a prairie, is an example which may thus be traced to the work of beavers. The sand along the road which runs across the marsh was washed up from the bottom of the lake, where it was originally deposited as a part of the Valparaiso moraine.

The principal prairies of Porter County are Twenty Mile Prairie, in Portage and Union townships; Morgan Prairie, in Morgan Township, and Horse Prairie, in Porter Township. In Lake County, Robinson's Prairie, near the center; Lake Prairie, in the southwest, and Eagle Creek Prairie, in the southeast, are the largest, most fertile and most beautiful.

When the two counties were first settled the wooded islands and the timbered uplands, with their clayey and sandy soils, were considered more valuable than the prairies. The settlers had come from well-timbered countries and had the erroneous belief that land that would not produce trees would not produce cereals. Many of the prairies, as Twenty Mile Prairie, Whippoorwill Prairie, and much of Morgan Prairie in Porter County, and those on the northern half of the morainic region in Lake County, were wet prairies, and for years yielded only swamp hay and pasture.

At present the prairie soils are considered far more valuable than those of the woodlands. The elements entering the former through the medium of decayed aquatic plants and animals have been in proper proportion and in sufficient quantity to give them extraordinary fertility. Their depth is so great that successive crops of the same kind can be cultivated year after year; the lower portions being as rich in the necessary elements of plant food as are the upper.

FARM PRODUCTS.

Especially are these prairie soils suited to the production of grass and hay. As natural meadows, they fed for centuries countless numbers of buffalo and deer. They now yield for the domestic animals of man thousands of tons of the best of timothy and wild hay.

Hay Production. In 1896 Lake County ranked second and Porter County third among the 92 counties in the State of Indiana in the production of timothy hay. The former produced 36,560 acres, yielding 49,356 tons;* the latter, 25,570 acres, yielding 34,438 tons. This does not include the upland prairie hay nor the lowland marsh hay. Probably as many or more tons of the latter are produced than of the timothy, though statistics are not available. Thousands of acres are annually cut, stacked, baled and shipped to Chicago. If the yield of timothy hay is short, good prices are realized. If timothy is plentiful, much of the marsh hay must be sold for bedding and packing at lower prices. Wild hay from upland prairies ranks next to timothy in quality, and sometimes brings even a better price. The largest hay fields in the State are in these two counties. In the northeast corner of Pleasant Township, Porter County, in 1897, were two full sections—1 and 12 (33 north, 5 west)—of raw prairie in one field, every foot of which was mowed. Another field, containing 2,000 acres, formerly in meadow, but now pastured, lies north of Fuller's Island, in Cedar Creek Township, Lake County. It has been partially reclaimed by the Griesel and Singleton ditches.

* Allen County ranked first by a very small margin, producing 36,826 acres and 49,715 tons. These figures are from the 12th Report, Indiana Dept. of Statistics, 1896, 436.

The prairie soils also yield bountiful crops of corn and oats, but wheat is not a success, especially in Lake County, where, in 1897, but 809 acres, yielding 12 bushels per acre, were produced. *Production of Cereals.* The freezing of the soil causes it to "heave" and throw out the roots of the plant, and the latter winter-kills. In Porter County, especially on the uplands of Washington, Jackson, Liberty and the eastern half of Center townships, a much larger acreage is sown; the average for the last three years being about 12,000 acres, with an average yield of nine bushels to the acre.

Much of the sand-covered area of the two counties, now considered waste land, will be found to be admirably adapted to the raising of small fruits and certain vegetables. Wherever wild berries and wild grapes grow luxuriantly, there, with a little care, can tame ones be successfully cultivated. Within recent years the growing of strawberries has been carried on to quite an extent on the sandy lands in the vicinity of Furnessville. This fruit is especially suited to a sandy soil, and hundreds of acres could be grown in the Calumet region on land which now produces nothing but weeds. Where they have been planted and given proper attention they have yielded bountifully and have found a ready market in Chicago. The raising of raspberries has also proven successful in the same vicinity, as well as on the sandy lands southwest of Kouts, in Pleasant Township, Porter County.

On the crests and slopes of the higher sand ridges along the shores of Lake Michigan wild grapes grow abundantly, and the fruit reaches a large size. The vines spring, apparently, from a mass of pure dry sand. But a careful examination will soon show that only the surface of the sand is dry. Six or eight inches below the surface there is moisture even in the dryest of seasons. It rises, by capillary attraction, from the very base of the ridge or dune, and the surface itself would be moist were it not for the constant evaporation. Moreover, the sand is not pure silica, but contains sufficient calcareous and organic matter to furnish plentiful food for the wild grapes, wild grasses and numerous shrubs and trees which spring from its surface. That tame grapes will thrive and yield abundantly on these sands has been proven by Mr. A. Stamford White, of Chicago. In 1894 he planted in Concord grapes three acres on the southern slope of a sand ridge, in section 3, Pine Township, Porter County. On September 10th, 1897, each vine was loaded with as fine fruit as one could wish, which was just ripening. The only drawback was due to the exceptional drouth of that season, which had caused the leaves of some of the vines to shrivel and drop, and so exposed the fruit to the blistering rays of reflected

sunlight. This would not happen in an ordinary season. Numerous peach and cherry trees had also been planted on the same ridge and were growing thriftily, but were yet too young to bear. Plum trees will also doubtless bear well, since many clumps of wild trees were noted on the "sand islands." Wild huckleberries grow plentifully in the Calumet region, and from Tolleston a thousand bushels a year were formerly shipped.* The huckleberry seems to be especially adapted to the sandy ridges, and is one of the most prolific and highly esteemed of the wild midsummer fruits.

The more level sandy areas, when first cultivated, produce for a few seasons excellent sweet potatoes, watermelons and pumpkins. By a careful system of fertilization a plentiful yield of all vegetables which flourish best in a sandy soil could be obtained. This has been proven in a locality along the Monon Railway, south of Hammond, where, for several seasons, hundreds of carloads of night soil have been shipped from Chicago and used as a fertilizer. As a result, an abundant yield of vegetables has been obtained from land once thought to be barren. These are in turn shipped to the Chicago market, thus furnishing a pointed example of that constant circulation of matter forever going on.

In the marshes wild cranberries grow indigenously, and when the season is not too dry excellent crops are produced. Much of the marsh land now uncultivated could be made to yield a handsome revenue if planted to this fruit. The largest, best-flavored and highest-priced berries can be readily grown on drained marsh land which has been properly prepared by cultivation so as to remove the natural growth of bushes, weeds and grass; and which can be flooded in late autumn and early spring. Where muck underlies the sod the latter should be removed and about four inches of sand mixed with the former: since the muck alone produces plentiful vines but few berries. Four years are necessary for the plant to come into full bearing, when the yield is from 100 to 150 bushels per acre, the wholesale price of the better berries being seldom less than \$2.00 per bushel. Plentiful water for flooding the marshes can be readily obtained by putting down driven wells and equipping them with windmill pumps. By this means also water in unlimited quantity can be had for irrigating fruits and vegetables grown on sandy lands adjacent to the marshes. Large areas of the marsh land now uncultivated will also produce paying crops of peppermint and celery, both of which plants require rich, moist soil for their successful raising.

* Ball, Rev. T. H.—Lake County, 1884, 159.

Next to hay, the most valuable farm product of the two counties is milk. Among Indiana counties, in 1897, Lake ranked third, and Porter fifth, in number of milk cows, there being in the former 9,832 and in the latter 8,218.*

The numerous railways passing through the counties to Chicago have each one or more daily "milk trains," which stop at platforms erected at intervals of two or three miles and gather up the liquid product for the Chicago market. The demand for milk in that city is constantly on the increase. The cash return therefor is sure, profitable and quick to reach the producer's pocket. As a result, the number of dairies in the two counties is constantly increasing, while the acreage devoted to the raising of cereals grows proportionally less.

*Production
of Milk.*

Fifty years ago Lake and Porter counties contained much valuable timber, but the older and larger trees have almost all been removed, and what remains is mostly "second growth." As already noted, the wooded groves or "sand islands," of both the prairie and the marshes, are thickly covered with small-sized black oak, *Quercus velutina* Lam., white oak, *Q. alba* L., bur-oak, *Q. macrocarpa* Michx., and in places the shell bark and pignut hickories, *Carya alba* Nutt., and *C. porcina* Nutt. Much underbrush exists among these trees, and about the borders of the islands, especially sassafras, hazel, crab-apple and hawthorne shrubs.

Timber.

On the sand hills along the northern border, notably in Porter County, grew many large-sized white pine, and black and white oaks, but sawmills were erected in several localities on the lake shore, and the hills were soon stripped. The gray or northern scrub pine, *Pinus banksiana* Lambert, now far outnumbered the white pine in that region.

No hard or sugar maple trees and but few beech grow indigenously in Lake County, but on the clay uplands of Jackson and Pine townships, in Porter, they are found in numbers. Here, also, grow red oak, *Q. rubra* L., shingle oak, *Q. imbricaria* Michx., and the wild cherry. Sycamore, river or red birch, *Betula nigra* L., and the soft or silver maple, occur along the banks of the Kankakee and the Little Calumet, but they do not reach the size which they attain in central Indiana.

MINERAL PRODUCTIONS.

Porter and Lake are pre-eminently agricultural and manufacturing counties and contain but few mineral productions of value. No coal or building stone occur within their bounds, and neither natural gas

* Allen County was first with 11,002; Marion second, with 10,016, and St. Joseph fourth, with 8,716.

nor petroleum have as yet been found. Deposits of clay suitable for

Clay. making pressed front brick, terra cotta lumber and other high-grade clay products are located near Hobart, Porter

and Chesterton, on the Deep and Calumet rivers. Clay suitable for ordinary brick and drain tile occurs in a number of localities in the morainic region. These deposits are described in detail in another paper in the present volume.

Molding sand of excellent quality occurs in abundance at several localities in the two counties. The best-known deposits are on the lands of L. H. Robbins and Theodore Swear, near McCool, Porter

Molding Sand. County, sections 7, 8 and 17 (36 north, 6 west). These deposits occur over the greater portion of the three sections, and shipments have been made from them for six years.

In 1897 a carload a day was shipped from the Swear land (section 17) to the Illinois Steel Company, at South Chicago, and four cars a week from the Robbins land to foundries in Chicago. The owners haul the sand to McCool and load it on the cars, receiving from \$7.50 to \$10.00 per carload at that station. The principal bank on the Robbins land, one-half mile northeast of McCool, showed the following exposure:

Soil	1 foot.
Fine grained buff clay containing much silica or free sand—"loam"	2 feet.
Coarser, darker molding sand.....	3.5 feet.

The soil is stripped; the "loam" separated from the molding sand and sold for lining ladles and cupola furnaces, and the molding sand for making castings. Each foot in thickness yields about 70 carloads per acre.

Southeast of Valparaiso, in southwest quarter of section 34 (35 north, 5 west), and north half of section 3 (34 north, 5 west), are also deposits of molding sand, much of which has been shipped to Chicago in recent years. The main deposits are close alongside the "Nickel Plate" Railway. The sand here is a dark brown, averages from two and one-half to three and one-half feet in thickness, and is overlain by six inches of soil. On the roadside one-fourth of a mile east of the Methodist Church, near the center of section 15, Washington Township, Porter County, is also an exposure of molding sand, deeper-red in color and three feet in thickness. It underlies six inches of soil and overlies a thick deposit of ordinary sand.

In Lake County the only deposit of molding sand noted was one and a half miles southeast of Hobart, on the land of William Frank, southeast quarter of section 33 (36 north, 7 west). Where exposed, this deposit is from eight to ten feet thick and is overlain by eight

inches of soil. It has been tested in Chicago and in the foundry at Hobart, and is pronounced of excellent quality. The Nickle Plate Railway runs within one-eighth of a mile of this deposit, which doubtless covers the greater portion of the quarter section. The following record of a bore put down 200 yards south of the above exposure was furnished by Mr. Frank:

Soil	1 foot.
Molding sand—heavy	4 feet.
Molding sand—lighter	4.5 feet.
Blue sand	6 feet.
Blue clay	76 feet.
Blue sand and clay mixed.....	96 feet.
Total	187.5 feet.

Both this deposit and the one near McCool are within the area at one time covered by the bay of Lake Chicago, mentioned on page 33, and were doubtless deposited by that sheet of water.

Peat exists in quantity in many of the marshes of the two counties. In Lake it is especially abundant in the Cady Marsh, northeast of Dyer. In Porter, the marsh north of Furnessville and the one along Sandy Hook Creek, in Morgan Township, contain it in great abundance. It is formed by the partial decomposition of plants beneath the surface of the water.

Peat and Bog Iron Ore. The gaseous constituents of the plants mostly escape, but the carbon is left behind. The decay of the plants is prevented by the water, which shuts off the free oxygen of the air, the main agent of all decay, and also by a peculiar antiseptic property which peat itself possesses. Each generation of plants takes gaseous carbon dioxide from the air, solidifies it within the plant body, and then adds it to the soil. A bog is therefore composed of the solid matter of thousands of generations of plants. The peat can be readily cut, dried and pressed into a valuable domestic fuel. At one time quite an industry of this kind was started at the Cady Marsh, but cheap coal, brought in by the many railways, has brought it to an end.

Beneath the peat bogs, especially in the Calumet region, there usually occur great quantities of limonite or bog iron ore. In the marsh north of Furnessville masses of it weighing many hundreds of pounds have been unearthed. This ore is too impure, however, to compete with the hematite and other high-grade iron ores of the Lake Superior, Missouri and Georgia mines. At one time a large blast furnace for reducing the bog ore of the Kankakee region was in operation at Mishawaka, St. Joseph County, but, like a number of others in central and southern Indiana, it has long since gone out of blast.

Gravel suitable for road purposes should be found in quantity in the higher ridges of the morainic region, but a careful search has not, as yet, revealed its presence. It is plentiful in the clay soil of the

Gravel. uplands, and seems to have been scattered through this soil and not accumulated in vast beds as in the moraines of central Indiana. The largest deposit noted in Lake County was near West Creek, in section 7 (32 north, 9 west). It was excellent in quality, but was but two and one-half feet thick, and was overlain with three feet of earth and underlain with coarse sand. It is my opinion that careful investigation will yet reveal large deposits of gravel in the higher ridges east and west of Lowell, and in some of those north and west of Hebron.

Several small deposits have been found just south and west of Valparaiso, one of which, called "Sugar Loaf," 20 feet in height and covering half an acre, was used on the streets of that city. A deposit three feet and more in thickness was noted east of Bell Marsh, on the side of the Valparaiso and Laporte road, in the southeast quarter of section 10 (35 north, 5 west). The appearance of the surrounding country is very favorable to the discovery of large deposits in this vicinity. The absence of good road material is a great drawback to the rapid development of the two counties, most of the gravel which has heretofore been used having been shipped in at great expense from Joliet, Illinois.

In September, 1897, it was reported at Chesterton that an outcrop of rock, *in situ*, had been discovered near Gosset's mill, in the western part of Liberty Township, Porter County. A visit to the place showed that on the land of John Tratebas, northwest quarter of section 21 (36 north, 6 west), the supposed rock was being taken out from a bluff of Salt Creek. The following section was exposed:

- | | |
|--|----------------|
| 1. Soil and clay | 2.5 feet. |
| 2. Sand, strongly impregnated with a solution
of carbonate of lime..... | 14 feet. |
| 3. Calcareous sandstone formed by the ce-
menting action of carbonate of lime on
the grains of sand..... | 4 to 6 inches. |
| 4. Sand | 3 feet. |
| 5. Gravel | 6 inches. |
| 6. Blue clay | ? ? |

The sandstone, No. 3, was evidently of very recent formation, and the blocks of it were very rough, uneven and irregular in size. The owner was endeavoring to get out enough of it to strengthen the mill dam, but found it a difficult task on account of the heavy overlying

deposit of sand. The cementing principle being carbonate of lime, readily soluble in rainwater, the stone, when exposed, will doubtless soon disintegrate into loose sand.

Other than bowlders, this was the only stone noted in the two counties, and the assertion was frequently made by citizens that no outcrop is known. Richard Owen, however, in his Report of a Geological Reconnaissance of Indiana, 1859, 205, makes the following statement:

"On Mr. Howell's elevated land, about three-quarters of a mile southeast of Valparaiso, on section 30 (35 north, 5 west), we were shown good gray crystalline limestone which had been quarried and burned into lime; but as the layer is only two or three feet thick, and apparently local in extent, it was soon abandoned. Unfortunately, no fossils were found, the lithographic or lithological character, however, indicates a rock of Upper Silurian age."

This statement was not observed until after my return from the field. The only information I have since been able to gain concerning the stone mentioned is from Henry Rankin, of Valparaiso, as follows: "I have interviewed Judge Wm. Johnstone about the limestone. He was raised within a mile of it. When a boy he has seen Mr. Howell burn lime on the northwest quarter of the section cited. He describes the stone as not in strata, but set up on edge, and says there were several cords of it." It is more than probable, therefore, that the stone mentioned by Dr. Owen was of drift origin, and not formed *in situ*.

Numerous springs occur throughout the counties, but the water is, in general, free from mineral constituents. At the Willow Dale

Mineral Stock Farm, one-half mile north of Crown Point, are, however, several fine springs which yield a copious supply of mineral water. The owner, Mr. W. J. Davis, kindly furnished the following copy of an analysis made by Dr. T. C. Van Nuys, formerly chemist at the State University:

ANALYSIS OF WATER FROM WILLOWDALE SPRINGS NEAR CROWN POINT, IND.

	<i>Grains Per Gal.</i>
Potassium sulphate—potash salts (K_2SO_4)	0079.94
Sodium sulphate—Glauber's salts (Na_2SO_4)	0011.31
Sodium carbonate—carbonate of soda (Na_2CO_3)	0139.79
Sodium chloride—common salt (NaCl)	0018.34
Aluminum sulphate—aluminum salts ($Al_2(SO_4)_3$)	0065.24
Calcium bicarbonate—salts of lime ($CaH_2(CO_3)_2$)	1929.06
Magnesium bicarbonate—salts of magnesia ($MgH_2(CO_3)_2$) ..	1165.08
Silicic acid ($Si(OH)_4$)	0166.39
Total	3575.15

The water is colorless and clear. Specific gravity, 1.0002. No iron or manganese was found. T. C. V.

At Hammond mineral water flows from six artesian wells, which average about 1,840 feet in depth, and at East Chicago, from one, 1,830 feet in depth. Two of those at Hammond are located on the grounds of the Western Starch Association, and the water flows from a vein which was struck at 1,850 feet.

A chemical analysis of this water, which will probably hold good for that flowing from the other wells at Hammond, showed the presence of the following mineral salts:

ANALYSIS OF ARTESIAN WATER FROM WELLS ON GROUNDS OF THE WESTERN STARCH ASSOCIATION AT HAMMOND, IND.

	<i>Grains Per Gal.</i>
Silica	1.022
Oxide of iron and aluminum.....	.058
Carbonate of lime.....	10.003
Carbonate of magnesia.....	9.283
Sulphate of soda.....	29.894
Chloride of sodium.....	20.913
Carbonate of soda.....	3.260
Sulphate of lime.....	38.308
Total	112.741

Two artesian wells, flowing water of high repute, are located in Porter County. One is the Blair well, in the extreme northeastern corner of the county, about one and one-half miles southwest of Michigan City. This well flows about 80 gallons per minute of water which a few years ago was much used for medicinal purposes. A bathhouse and sanitarium were erected, and many guests visited the place each year and were benefited by the treatment. Since the death of the owner the use of the water has been practically abandoned. The depth of this well was 840 feet, and an analysis of the water by Dr. P. S. Hayes, of the Chicago College of Pharmacy, showed the presence of the following mineral salts:

ANALYSIS OF ARTESIAN WATER FROM BLAIR WELL, NEAR MICHIGAN CITY, INDIANA.

	<i>Grains Per Gal.</i>
Chloride of sodium (NaCl).....	360.4794
Chloride of magnesium (MgCl ₂)	45.6550
Sulphate of potassium (K ₂ SO ₄)	17.9968
Sulphate of magnesium (MgSO ₄).....	31.9730
Sulphate of calcium (CaSO ₄)	84.4024
Bicarbonate of calcium (CaH ₂ (CO ₃) ₂).....	147.8503
Silica (SiO ₂)	1.7523
Total solids determined	690.1092
Hydro-sulphuric acid, total in volume at 62° F,	11.1719 cubic inches.

The second well flowing mineral water in Porter County is located on the grounds of the Chicago Hydraulic Press Brick Company, at Porter, twelve miles southwest of Michigan City. It was bored in search of gas to a depth of 860 feet, and at present flows about 75 gallons per minute of water which is highly charged with hydrogen sulphide, as well as the following mineral salts:

ANALYSIS OF THE PORTER ARTESIAN WATER.

	<i>Grains Per Gal.</i>
Sodium chloride—common salt (NaCl)	208.76
Calcium chloride—chloride of lime (CaCl_2)	51.93
Magnesium chloride—salts of magnesia (MgCl_2)	38.71
Ammonium chloride—salts of ammonia (NH_4Cl)	0.44
Potassium chloride—potash salts (KCl)	13.18
Potassium sulphate—potash salts (K_2SO_4)	17.08
Calcium carbonate—carbonate of lime (CaCO_3)	11.14
Silica	1.10
Total	342.34

This analysis was made by Dr. J. H. Salisbury, Professor of Chemistry in the Women's Medical College, Northwestern University, who speaks of the water as follows: "The water from Porter is very free from injurious organic matters. It is very useful for drinking at the well in cases which need alterative or laxative treatment; and is also useful for baths and for sanitarium purposes. Its sulphuretted hydrogen will not be long retained if exposed to the air."

RAILWAYS.

The 920 square miles comprised in these two counties is less than one-fortieth of the area of Indiana, yet they contain more than one-fourteenth of the total miles of railway in the State. Of the \$154,841,971 of railway property assessed in Indiana in 1897, \$15,539,249, or more than one tenth, is within these counties and pays taxes into their treasuries.

Among Indiana counties, Lake easily ranks first in the number of miles of railway within her bounds. Porter stands third, being excelled only by Laporte, her much larger eastern neighbor. Nine great trunk lines cross both counties from east to west and in Lake the Monon runs almost the full length of the county from north to south. The two counties thus stand at the main door of entry into Chicago. Across their bounds all passengers to and from that city to the Eastern States must travel.

Besides these ten great systems, five belt railways, each connecting with almost all the roads entering Chicago, cross a portion or all of

Lake County, and one of them, the Elgin, Joliet & Eastern, extends nine miles into Porter. The principal business of these belt roads is the transferring of freight from the main trunk lines east of Chicago to similar lines running west from that city. Crossing and intersecting, as they do, the Calumet region, they give to that area most excellent shipping facilities. Many capitalists have, of recent years, availed themselves of these facilities, and about Hammond, East Chicago, Whiting, Hobart, Porter and Chesterton have been located some of the largest and most flourishing factories in Indiana. In fact, its many railways, its proximity to Chicago and the cheap prices at which factory sites can be secured within its bounds, now mark the once despised and little valued Calumet region as one of the future great manufacturing districts of the world.

In order to give exactly the railway statistics of the two counties, the following table from the "Proceedings of the Indiana State Board of Tax Commissioners for 1897" is inserted:

Railway Statistics of Lake and Porter Counties in 1897.

NAMES OF ROADS.	MAIN TRACK.			SECOND MAIN TRACK.			SIDE TRACK.			ROLLING STOCK.			Improvement on Right of Way.	Total of Roads.	Total of Counties.
	Miles.	Per Mile.	Total.	Miles.	Per Mile.	Total.	Miles.	Per Mile.	Total.	Miles.	Per Mile.	Total.			
LAKE COUNTY.															
Baltimore & Ohio & Chicago.....	17.86	\$22,000	\$392,920	11.42	\$4,000	\$91,360	11.59	\$3,500	\$40,555	17.86	\$2,500	\$44,650	\$1,400	\$570,955	
Chicago & Erie.....	24.42	25,000	610,500				17.16	3,500	60,160	24.42	2,500	61,050	6,500	139,800	
Chicago & Lake Shore Eastern.....	7.94	10,000	79,400	7.51	5,000	37,550				7.94	1,500	11,910	2,500	199,260	
Chicago & Calumet Terminal.....	10.93	18,000	196,740	.90	6,000	5,940	12.82	3,500	44,870	10.93	3,000	32,790	3,000	281,040	
Chicago & Grand Trunk.....	16.53	32,000	528,960				3.83	4,000	15,320	16.53	3,500	57,855	3,000	605,735	
Chicago, Hammond & Western.....	3.82	2,500	9,550				.40	1,500	600				1,100	10,250	
Elgin, Joliet & Eastern.....	23.70	20,000	474,000				7.76	3,000	23,280	23.70	2,500	59,250	2,700	559,250	
East Chicago Belt.....	3.04	2,000	6,080											6,080	
Lake Shore & Michigan Southern.....	18.25	40,500	739,125	18.25	10,000	182,500	7.45	4,000	29,800	18.25	6,000	109,500	1,750	1,622,575	
Louisville, New Albany & Chicago.....	33.54	16,500	552,754				10.98	3,500	38,080	33.54	2,500	83,850	2,000	690,980	
Michigan Central.....	16.40	32,500	533,000	16.40	10,000	164,000	11.41	3,500	39,935	16.40	5,000	82,000	6,170	829,105	
Montpelier & Chicago.....	10.81	14,000	151,340				3.09	3,000	9,270	10.81	3,000	32,430	1,900	193,840	
New York Chicago & St. Louis.....	18.03	32,000	576,960				5.65	4,000	18,200	18.03	3,000	54,090	1,770	655,420	
P. C. & St. L. (Chicago Division).....	22.12	34,000	752,680				8.37	4,500	37,665	22.12	5,000	110,600	3,885	904,220	
Pittsburgh, Ft. Wayne & Chicago.....	20.07	56,500	1,133,955	20.07	10,000	200,700	10.54	5,000	52,700	20.07	7,000	140,480	6,475	1,534,220	
State Line & Indiana City.....	7.56	7,000	52,920				3.16	3,000	9,480				2,800	182,040	
Indiana, Illinois & Iowa.....	11.26	15,000	168,900				1.02	3,000	3,060	11.26	1,500	16,890	600	189,540	
Joliet & Northern Indiana.....	15.51	16,000	248,160				2.29	3,000	6,870	15.51	2,500	38,775	2,080	235,855	
Total.....	291.79		\$7,211,354	74.61		\$682,030	122.41		\$430,935	297.37		\$9,61,130	\$18,055		\$9,308,584
PORTER COUNTY.—															
Baltimore & Ohio & Chicago.....	16.59	\$22,000	\$361,980				4.11	\$1,500	\$14,385	16.59	\$2,500	\$41,475	\$2,600	\$223,530	
Chicago & Erie.....	16.82	25,000	415,500				3.50	3,500	12,250	16.82	2,500	41,550	1,450	470,750	
Chicago & Grand Trunk.....	15.28	32,000	488,960				4.91	4,000	19,640	15.28	3,500	53,480	12,340	574,420	
Chicago & Indiana Coal.....	3.22	14,000	45,080				.14	3,000	420	3.22	2,000	6,440		51,940	
Elgin, Joliet & Eastern.....	9.12	20,000	182,400				1.11	3,000	3,300	9.12	2,500	22,800	850	218,980	
Lake Shore & Michigan Southern.....	15.57	40,500	630,585	15.57	\$10,000	\$155,700	10.37	4,000	41,480	15.57	6,000	93,400	3,880	925,045	
Michigan Central.....	17.04	32,500	553,800	17.04	10,000	170,400	5.01	3,700	17,535	17.04	5,000	85,200	4,100	831,035	
Montpelier & Chicago.....	16.61	14,000	232,540				2.38	3,000	9,140	16.61	3,000	49,890	1,310	390,820	
New York Chicago & St. Louis.....	19.97	32,000	639,040				1.98	4,000	7,920	19.97	3,000	50,910	1,250	603,120	
P. C. & St. L. (Chicago Division).....	15.48	34,000	526,520				5.34	4,500	24,180	15.48	5,000	77,400	2,580	630,130	
Pittsburgh, Ft. Wayne & Chicago.....	16.47	56,500	930,555	12.57	10,000	125,700	4.51	5,000	22,570	16.47	7,000	115,230	17,200	1,211,435	
Total.....	188.97		\$4,913,790	45.18		\$451,900	46.36		\$17,4980	188.97		\$687,795	\$47,630		\$5,230,065

WOLF LAKE HARBOR.

Since Indiana at present possesses but one harbor on the shore of Lake Michigan, namely, the one at Michigan City, the question of opening another at Wolf Lake, north of the city of Hammond, has been agitated for several years past.

Wolf Lake is located in the northwest corner of the State of Indiana and in the northeast corner of the State of Illinois, within 500 feet of Lake Michigan. It has an area of about five square miles and is from three to fourteen feet deep. It is surrounded and touched by ten great trunk lines of railway, viz.: Baltimore & Ohio; Lake Shore & Michigan Southern; Pennsylvania; Wabash; Chicago & West Michigan; Michigan Central; New York, Chicago & St. Louis; Chicago & Erie; Chicago, Indianapolis & Louisville, and the Pandhandle; and by five belt lines of railway, viz.: Lake Shore & Eastern; Chicago Belt Line; Chicago & Calumet Terminal; Elgin, Joliet & Eastern, and Chicago Terminal Transfer Company. These belt lines pass around the city of Chicago, crossing and connecting with the 24 great trunk lines terminating in that city. Two eight-inch pipe lines from the oil fields of Ohio and Indiana, through which is pumped crude oil for fuel and for refining in the largest oil refinery in the world, located at Whiting, just east of Wolf Lake; and two eight-inch pipe lines from the natural gas fields of Indiana also pass close to the borders of the proposed harbor.

The existing natural advantages for a harbor at Wolf Lake over those of the Chicago River and the Calumet River are many and have been summarized as follows:

First—The entrances to the Chicago and Calumet harbors are from the east; that of Wolf Lake would be from the north. The storms that wreck the vessels on the south coast of Lake Michigan are from the north. Only three years ago 23 vessels were wrecked in one storm on the shores of Lake Michigan, near Wolf Lake. Why they were unable to make the harbors at Chicago and Calumet can readily be seen. If there had been a harbor at Wolf Lake, such as is now proposed, it is believed that all of these vessels could have entered in safety. The same cause that wrecked so many vessels in this storm wrecks vessels there every year.

Second—The Chicago and Calumet rivers are narrow—200 feet wide and less—and must of necessity always remain so. A strip 300 feet wide from Lake Michigan to Wolf Lake has been dedicated to the government, and the riparian owners propose to donate all their right,

title and interest in and to so much of said lake as the government may wish, to make a commodious inland harbor for commercial and naval purposes.

Third—The Chicago and Calumet rivers are filling up from sewage and other causes from eight to twelve inches per year, as shown by the engineer's report, and are continually forming bars at the end of the jetties. Such continual filling requires a constant dredging, equal in amount to that required to dredge a new river the full length, width and depth of the proposed improvement, once in every 12 to 15 years. Wolf Lake has not filled one foot since Columbus discovered America. The sand on the bottom of this lake is as clean and bright as it was 400 years ago, and, once dredged, will ever remain so.

Fourth—It is conceded by all that the bridge and tunnel nuisance of Chicago adds 25 per cent. to freight, and what is true of Chicago is to a great extent true of the Calumet, and will continually grow worse. The people of Hammond, in common with all the great Northwest, have to bear this extra freight. Wolf Lake is not and never will be bridged or tunneled.

Fifth—Narrow rivers are poor harbors of refuge. They are broader at the entrance than at any other place, and as the waves converge they grow higher and more vile; hence Chicago is asking for outer harbors. Every one of theoretical or practical knowledge must know that outer harbors are of little value compared with inland harbors, and that they are maintained at an enormous expense. To the inland harbor at Wolf Lake the vessels could go for refuge, and, while the storm was raging upon the sea, they could load and unload their cargoes in safety.

Major Marshall, the engineer in charge, says that Wolf Lake must eventually be the terminus of the Lake Michigan and Mississippi waterway. All the country, including the Little and Grand Calumet rivers and the cluster of small lakes near the southern shore of Lake Michigan, is known locally as the Calumet region. Of it Major Marshall says: "Here the manufacturer recognizes a location after his own heart. Here, converged by lake, rail and pipe lines, are iron, lumber and copper from Michigan, bituminous coal from Illinois and Indiana, anthracite and coke from Pennsylvania, and crude oil and natural gas from Indiana. Here is a large resident laboring populace. Here is the market—the great Northwest—and here are shipping facilities unrivaled in the world. Here the car or vessel can be loaded and leave without delay on any of the 24 trunk lines of railroads, or the Great Lakes, direct for almost any point in the United States or Canada. The terminal facilities, access to Lake Michigan at numerous points

along the Calumet River and system of lakes connected therewith; the ample land-locked natural basin, needing only deepening by dredging for the construction of great wharves and derricks, will furnish a commodious harbor scarcely excelled in or on the Great Lakes. All these advantages point irresistibly to the Calumet region as a proper terminus of a great waterway between the Great Lakes and the Mississippi River."

Much work has already been done by private individuals which can be utilized towards the construction of a future harbor. A brief resumé of this work is as follows: 100 feet of inside work, well and substantially built, to prevent Lake Michigan from cutting behind the piers; a 600-foot pier, of the best quality of white oak, worth, according to the United States Engineer's report, \$18,000, built from the water's edge 600 feet out into Lake Michigan from the northwest side of the harbor; 375,000 cubic yards of dredging in Wolf River and Lake at a cost of over \$30,000. The interest of private individuals in the project keeps a dredge continually at work in Wolf Lake on the line of the proposed improvement. The sand dredged out of the proposed basin will be required to fill in around the margin of the lake outside of the dock line.

Such a harbor as is proposed would be of inestimable value to the people of Indiana as a whole. That the people outside of the immediate vicinity are interested in the project is evidenced by the fact that all the State officials, the Board of Trade of Indianapolis, and the entire delegation of Congressmen and Senators of the State, two years ago united with the people of Lake County in a petition to Congress for an appropriation. Congress appropriated \$8,000 towards the work, but as there had been no plans prepared by the War Department, the Engineer in charge refused to expend the money. The committee in charge succeeded in getting the extra session to re-appropriate the same sum in the Sundry Civil Bill, and the President vetoed the entire bill.

Among Indiana cities, Hammond at present ranks next to Indianapolis as a manufacturing center. The 967 factories which were reported to the State Statistician in 1896 showed an annual productive output of \$132,713,421. Of this sum the factories of Indianapolis contributed \$27,770,820; those of Hammond, not including Whiting or East Chicago, \$20,245,099, and those of Ft. Wayne, which ranked third, \$9,509,627. The population of Hammond, East Chicago and Whiting, the towns surrounding Wolf Lake, is about 40,000. Thirty-seven large industries, with an invested capital of more than twenty millions of dollars, are located in these three cities. These factories consume

annually more than 350,000 tons of fuel and ship more than three millions of tons of material. It is a well-known fact that transportation rates by water are less than one-third those by rail, yet, with the site for an excellent harbor within their very midst, the inhabitants and manufacturers of these cities must transport everything by rail. All these facts go to show that the harbor at Wolf Lake is practicable and needed. Every person in Indiana and the great Northwest who helps to pay the 25 per cent. additional freight made necessary by the defects of the other harbors at Chicago should use his energy in endeavoring to further the construction of a new Indiana harbor at Wolf Lake.

ARCHÆOLOGY.

Among the lakes, streams, prairies and dunes of the two counties the Red Man and his predecessor, the Mound Builder, found, for centuries, a dwelling-place congenial to their wants. There flesh and fur were plentiful. Fishes and mussels abounded in the streams and lakes. Wild fowl by myriads in their migrating seasons came and went, stopping to feed among the marshes. Buffalo, deer and grouse, in untold numbers, inhabited the prairies; while beaver, muskrat and otter crowded the overflowed basins of the Calumet and Kankakee. Nor was the food supply limited to flesh. Wild fruits—huckleberries, grapes, plums, cranberries, sand cherries and many others—flourished in profusion along the sand ridges. Wild rice grew by acres in the marshes, while acorns and the nut of the hazel and the hickory abounded in the groves.

Such an abundance and variety of food—ready for the taking—could but attract primitive man. The first white settlers found plentiful evidence of his former presence. On the "sand islands" and higher levels of the prairie and the marsh were his mounds and his burying grounds, and in places plots of cleared ground where had been his gardens and his fields. Many skeletons of Indians have been exhumed from the burying grounds. With them were usually found fragments of pottery, mussel shells, stone beads, flint arrowheads, bones of animals used as food, and, oftentimes, implements of iron. These remains denote that with the dead was buried food believed to be sufficient to last during the journey to the "happy hunting grounds."

South of Orchard Grove, Lake County, on a sand island now owned by John Brown, of Crown Point, northeast quarter of section 21 (32

Mounds in Lake County. north, 8 west), is the so-called Indian Battle Ground. When first noted by the whites a low breastwork or artificial ridge enclosed on two sides about three acres of ground. Within this enclosure were some 200 holes, each about three feet in diameter and four feet deep. They resembled individual rifle pits scooped in the sand. In 1897 the outlines of the ridge were still visible, and also many depressions where the pits had been. As to when and by whom the entrenchments were made, not even tradition furnishes a knowledge. Remains of similar breastworks and pits are said to exist on Oak Grove Island, section 16 (32 north, 9 west). Numerous skeletons have been found in the immediate vicinity of both entrenchments.

Several mounds are located about the shores of Cedar Lake. From one of these, on the north side of the lake, about twenty skeletons, some pieces of lead ore and some arrow points were taken in 1880. A bur-oak tree, six feet in circumference, and containing 200 rings of annual growth, grew on the mound above some of the human remains. The largest mound is on the west side of the lake. In 1837* its surface was 12 to 15 feet above the surrounding level, but is now much lower. So far as known it has never been explored.

On the farm of J. P. Spalding, south of Orchard Grove, northwest quarter of section 33 (33 north, 8 west), are the remains of two large mounds. They have been plowed over for almost sixty years, yet portions of human skeletons, arrowheads and pottery are still at intervals unearthed by the ever-leveling plowshare.

One mile south of Hobart, on the land of William Frank, southeast quarter of section 32 (36 north, 7 west), are the sites of four mounds which have been nearly leveled by cultivation. They have never been excavated, and only a part of a stone tomahawk and a few small flints have been found in the field in which they are located.

Just north of the mill at Woodvale, in a field annually overflowed by Deep River, is a large mound, in shape resembling a flat-iron. It is 190 feet in length by 75 feet in greatest width, and its surface is 22 feet above the level of the field in which it stands. Ball states† that in 1836 there was not a tree or shrub on its surface, but many oaks and other trees, some of which are 14 inches in diameter, now grow upon its crest. Although thought by most observers to be artificial, it is my opinion that it is a natural formation cut off from the surrounding highlands by the waters of Deep River. The artificial mounds of this region are always composed of clay, but the material

* Ball, Lake County, 1884, 333.

† Lake County, 1834-1872, 73.

thrown out by numerous woodchucks, 8 to 15 feet below its crest, shows this one to be composed largely of sand, which is the material underlying the surface clay in the highlands of the vicinity. Numerous other mounds are scattered here and there in Lake County, but, for the most part, they are small and but few of them have been systematically explored.

Among the private collections of prehistoric and other relics made in Lake County none excels that now owned by J. W. Youche, Jr., of Crown Point. It was mainly collected by W. W. Cheshire, now of Washington, D. C., while he was Clerk of the Court and County Superintendent of Lake County. It comprises several hundred stone axes, celts, hatchets, spearheads, pestles, mortars, hammers, gorgets, banner stones, etc., etc. Some fine spades, pipes, "shuttles" and chisels are also in the collection. Special mention can here be made of but six of the articles which are somewhat unique in character. First, a copper arrowhead (Fig. 1), $4\frac{1}{4}$ inches long by $1\frac{1}{4}$ inches wide, with three small notches on each side of the shaft. It was found in St. John's Township about five miles northwest of Crown Point. Second, a polished stone of whitish quartzite (Fig. 2), in shape and size somewhat like the half of an egg cut lengthwise. It has a spoon-shaped indentation on the flat side, and a lengthwise groove on the convex side. No description of such an article is found in any work on archæology at hand. It was found about five miles east of Crown Point, in Winfield Township. Third, a "shaft rubber" of fine sandstone (Fig. 3), six inches long, one-half inch thick and one inch wide, flat on both sides and edges and with a narrow groove running the full length of one side. It was found on the Kankakee Marsh, four miles southwest of Lowell. There was probably another part to correspond with the one in the collection, and the two were used in polishing the shafts of arrows. Fourth, a ceremonial stone (Fig. 4) made of compact reddish porphyry, very highly polished, double hatchet-shaped and with sharp edges. It was found in the northern part of Lake County. Fifth, a plummet or net sinker (Fig. 5), one and one-eighth inches in diameter, made of close-grained granite. It is smoothly polished and regular in shape, with a hole through one end for attachment, and was found in Lake County, near the Kankakee River. Sixth, a gorget (Fig. 6) made of fine-grained variegated slate, highly polished, and about three-sixteenths of an inch in thickness. One of its ends has 15 small notches cut in it, and it was probably used as a counting device. It was found near the central part of Lake County.

The last piece to be mentioned in this connection is more modern and is still in possession of Mr. Cheshire, who claims that "it is the



FIG. 1-4.



FIG. 2-7.



FIG. 3-4.



FIG. 4-4.



FIG. 5-4.



FIG. 6-4.



FIG. 7-4.

most unique specimen of its kind on earth." It consists of the breast-bone of a wild goose transfixed by a bone arrowhead (Fig. 7), 9 inches long, a half inch wide, slightly curved, and with four sides or faces. By request Mr. Cheshire kindly furnished the following information concerning it: "The goose was shot on the Kankakee Marsh south of Lowell, October 20, 1871, by H. N. Clement, a farmer living near the marsh. The very curious points about it are: (a) That the arrowhead should strike the keel of the breast-bone exactly in the middle; (b) that it should stop with its length exactly divided by the keel; (c) that the shaft to which it was evidently fastened should drop off when it struck the bone; (d) that a callous should grow around it, holding it fast; (e) that the goose should be fat and well after carrying it in that trans-fixed position. Prof. O. T. Mason, of the National Museum, says that no people of the world make such arrowheads except those of the Yukon Valley, Alaska; and he therefore concludes that the arrow was shot into the goose in that valley, remained there until it grew fast and the goose wore it as a breastpin down into Lake County, Indiana. The goose was going south when shot."

In the collection of Rev. T. H. Ball, of Crown Point, is a celt of hammered copper three and one-half inches long, one and one-half inches in greatest width and one-quarter of an inch thick. It was taken from a wolf's burrow just west of Cedar Lake. Nicholas Schutz, of Dyer, possesses a large collection made in that vicinity. In it are some fine "rolling pins" or cylindrical pestles and a small and very handsome granite pipe. Another collection of almost two thousand arrowheads, stone awls, banner stones, etc., is owned by Fred Black, of Hobart. A large number of these are from the Morrison Farm, near Liverpool, section 19 (36 north, 7 west), where a few years ago a cache containing numerous unfinished, as well as finished, flints was unearthed.

PORTER COUNTY has not been found to be as rich in prehistoric remains as has Lake. The High School at Valparaiso possesses a goodly collection, but the data pertaining to the specimens is mostly lacking, and a specimen without data loses more than half its value. On the farm of Hon. Nelson Barnard, section 21, Jackson Township, some fine specimens have been taken—among others a hammer of granite $4\frac{1}{2}$ by $3\frac{1}{2}$ inches in size, with a deep groove passing around the center. In the southeast corner of the county, on the farm of S. L. Stowell, section 2 (32 north, 5 west), a celt formed of diorite, finely polished and ten inches long, has been found; also a cache of more than a peek of flint arrowheads. Oliver Hoffman, of Boone Grove, has some fine specimens found in the vicinity of that town.

Dr. J. K. Blackstone, of Hebron, had also at one time a large collection from the south part of Porter County, but it has become scattered. In it was some pottery, taken from a mound on the Maxwell farm, south of Hebron, and a fine plummet from a point three miles southwest, near the Lake County line.

The mounds of Porter County are also much less numerous than those of Lake. Four miles east of Hebron, near Cornell Creek, section 9 (33 north, 6 west), one was excavated some years ago by Hon. G. C. Gregg, and a number of skeletons were found. The mound was composed wholly of black earth (muck?) which had been carried from the banks of the creek some ten rods distant.

The finest group of mounds in the two counties is located about one and a half miles a little north of east of Boone Grove, Porter County. At present eight are visible on an area of about 30 acres, but a number have probably been leveled by cultivation. Seven of the eight are in a piece of high wooded ground close to Wolf Creek. The one nearest the creek is the largest of those in the woods. It is 210 feet in circumference and its crest is 10 feet above the surrounding level. Growing on it are a number of black oak trees, one of which is 4.5 feet in circumference. A *second* mound is located 150 feet a little north of west. It is 170 feet in circumference and eight feet high, with a flatter top and fewer trees growing from it. One hundred yards to the northwest is the *third*, 180 feet in circumference and but four feet high, with a black oak 5.7 feet in girth growing from its side. These mounds are in the northwest quarter of section 34 (34 north, 6 west), the third being about 40 rods east of the section line. The *fourth* and *fifth* mounds are situated in the same quarter section, about six rods east of the section line and 1,000 feet south of the section corner. One is 175 feet in circumference and six feet high, the other 75 feet in circumference and four feet in height. Excavations were made in four* of the five mounds mentioned in October, 1897, but no skeletons or implements of any kind were found. Pieces of charcoal and ashes were quite common in three of them, and in the other several flakes of flint and a part of an arrowhead were secured. The *sixth* and *seventh* mounds are lower and about 100 feet in circumference. They are situated in the extreme southeastern corner of section 28 (34 north, 6 west), and have never, as far as known, been disturbed.

The largest mound of the group is located in a cultivated field in the northeast corner of section 33 (34 north, 6 west), 420 feet south

* No. 5, the larger of the two near the section line, was excavated by a party under my direction; Nos. 1, 2 and 4 by Supt. Wood of the Valparaiso schools, and a number of his pupils.

and 310 feet west of the corner of the four sections. It is 300 feet in circumference, 12 feet high, and almost a perfect sugar-loaf in form. The owner of the farm, Mr. John Wark, of Valparaiso, kindly gave his consent to the excavation of this mound, and on October 6 and 7, a ditch was dug three feet wide, 32 feet long, and, at the center of the mound, 14 feet in depth. The mound was found to be composed of a compact, yellowish clay, in which were a few scattered pebbles of small size. In the exact center and ten feet from the crest, the earth became darker, harder and more compact. Six inches lower was a layer of black organic matter, in which were the remains of a very badly decayed human skeleton. It lay in a reclining position with its head to the south. Only a few pieces of bone and 14 teeth were removed, the remainder crumbling to dust. The crowns of the teeth were hard and solid, but the fangs for the most part crumbled like the bone. No implements of any kind were found, though the excavations were extended four feet lower, and over an area 5x7 feet in the center of the mound.

In the original field notes of this locality, made by the United States Land Survey in 1834, the north and south line between sections 33 and 34 is said to pass over "a large artificial mound surrounded by a number of smaller ones," and a copy of the original plat now in the State Auditor's office shows this larger mound on the line, with nine smaller ones in a circle about it. As noted above, all the mounds are at some distance from the line, and if smaller ones surrounded the larger, as shown on the plat, they have long since been leveled by cultivation.

Who were the Mound Builders? Whence came they? Whither did they go? These questions are as yet unanswered, and probably ever will be. Their works and their implements show them to have practiced agriculture and to have been in many respects more civilized than their followers, and, perhaps, descendants, the Red Men. Their mounds are scattered throughout the Western States, in some places in great numbers. Some were erected for sacrificial purposes; some for signal or lookout stations—while more, perhaps, mark the burial places of their priests, their great warriors or their rulers. As we, by lifting heavenward a monument of granite or of bronze, pay tribute to the memory of our great men, so these primitive people built mounds of earth above their noted dead, giving to the chief or king the higher and more prominent.

NOTES ON THE FAUNA OF LAKE AND PORTER COUNTIES.

Each species of animal on earth has, in time, become adapted to a certain environment. If the elements of that environment be largely present in any prescribed area, the animal, or a closely allied form, may be sought for, even though its known center of distribution be in a far distant locality. The number and variety of animals inhabiting any limited area depends, therefore, upon the variety of its topography and the character of its soils. Possessing, as they do, lakes, rivers, swamps, upland woods, prairies and sand hills, Lake and Porter counties can but possess a large and varied fauna. To give anything like an accurate account of the fauna of such a region, one must reside therein for years. He must visit daily the haunts of the animals, note their coming and going, their food habits and their life histories. Passing, as I did, but hurriedly over the region, a few notes concerning such vertebrate forms as were seen, or those whose presence was deemed worthy of especial mention by the citizens of the counties, and all that can be given in this connection.

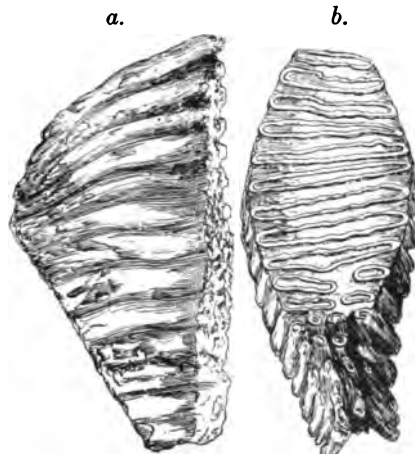
Many of the animals which once roamed over the area under consideration are now wholly extinct or are only represented by scattered individuals in the far West and North. Among the largest forms which inhabited this region at the close of the glacial period were the two American elephants, now extinct. The smaller of the two, known

as the mammoth — *Elephas primigenius* Blum.—was over twice the bulk and weight of the modern elephant and nearly one-third taller. It occurred in numbers over all of Europe and over the northern part of North America.

A number of specimens so well preserved that wolves and dogs fed



FIG. 8. Tooth of Mastodon.

FIG. 9. Molar Tooth of Mammoth.
a, side view; b, grinding surface.

on their flesh have been found frozen in the ice in Siberia. From these it was learned that in life the skin of the animal was covered with a brownish wool and in parts with long hair. It was therefore enabled to withstand the severe cold of the northern regions.

The mastodon—*Mastodon americanus* L.—was of still larger size, being 12 to 13 feet high and, including the tusks, 24 to 25 feet in length. Its remains are readily distinguished from those of the mammoth by the teeth. The difference is shown in Figs. 8 and 9. These two great mammals roamed in separate herds over the prairies and along the margins of forests, lakes and streams, where they often became mired and perished in the bogs. It is on the site of former marshes that their remains are now mostly found. A skeleton of the mastodon unearthed in Iroquois County, Illinois, in 1880, had between the ribs a crushed mass of herbs and grasses, the remains of its last meal. These, on close examination, were found to be very similar to those now growing in that vicinity.

In Lake County an almost complete skeleton of a mammoth was found in a marsh on the head waters of Deep River, in the north half of section 35 (35 north, 9 west), about two miles east of St. John's. In Porter County remains of the mastodon have been found in the following localities: In the Kankakee Marsh, section 25 (33 north, 7 west), three miles southeast of Hebron; in a marsh by the side of Cobb's Creek, just east of Hebron; near Sandy Hook Creek, northwest of Kouts, and on the farm of Peter A. Bair, southwest quarter of section 27 (35 north, 6 west), two miles southwest of Valparaiso. In each case but a few teeth and one or two bones were exhumed while ditching, and no extensive search was made for the other portions of the skeleton. Close to the teeth found near Kouts were the antlers of a large elk which had perished in the same bog. Antlers of the same species have also been found in Lake County.

Buffalo and deer were once common in the two counties, but the finding of an occasional skull or pair of antlers are now the only evidence of their former presence.

The Opossum, *Didelphis virginiana* Shaw, though an animal of southern range, is occasionally taken in small numbers in both counties. A pair of porcupines, *Erethizon dorsatus* (L.), are in the State Museum from Laporte County, and though no definite record of its occurrence in Lake or Porter was secured, it doubtless belongs to their fauna. The muskrat, *Fiber zibethicus* (L.), is one of the most common mammals in the Kankakee and Calumet basins. According to Ball, from 20,000 to 40,000 a year were trapped in Lake County alone previous to 1884. Except in the marshes that

have been drained, their numbers do not appear to become appreciably less. The remains of dams thrown up by the beaver, *Castor fiber* L., are found in a number of localities in Lake County, but the animal itself had disappeared before the coming of the first settlers. The woodchuck, *Arctomys monax* (L.), is common among the upland wooded ridges, as is also the chipmunk, *Tamias striatus* (L.). The little striped gopher, *Spermophilus tridecemlineatus* (Mitchell), is common on the prairies and among the sand ridges. The gray gopher, *S. franklini* (Sabine), locally called the "prairie squirrel," was seen on several occasions along hedge rows on the borders of prairies, and one, which had already entered a state of hibernation, was captured, October 6, in the large mound excavated near Boone Grove, Porter County.

The fox squirrel, *Sciurus niger* L., is very scarce, but a few are said to reside in the upland woods in Jackson Township, Porter County. The gray squirrel, *S. carolinensis* Gmlin., and the little red squirrel or chickaree, *S. hudsonicus* Erx., are common in the timbered areas. Jet-black specimens of the first named are occasionally seen.

The otter, *Lutra hudsonica* (Lacepede), was, in the early settlement, quite common, and a few are yet taken almost every Spring along the Kankakee. The skunk, *Mephitis mephitis* Cuvier, and the mink, *Putorius vison* (Schreber), are both rather common and both yield a considerable annual revenue to the professional trapper. The large gray timber wolf, *Canis lupis* L., once common, is still occasionally seen in the region of the Kankakee marshes, three having been killed by Oscar Dinwiddie in Eagle Creek Township, Lake County, in 1895.

About 16 additional species of mammals doubtless occur in the two counties, but the above constitute all which came to my notice or to which reference is made in my notes.

Mr. A. W. Butler, in his work on Indiana Birds in the present volume, has a number of notes pertaining to the birds of this region. For this reason no specific mention of those noted is given in this connection. Probably 225 or more species occur in the counties during a single year. Of these about 30 are *permanent residents*, i. e., reside in the region throughout the year. Common examples are the crow, blue-jay and quail. Probably 65 are *summer residents*, i. e., arrive from the South in the Spring, nest and rear their young, and depart southward again in Autumn. The orioles, catbird and chipping sparrow belong to this group. About 10 are *winter residents*, coming from the North in Autumn and departing northward in Spring, the snowbird and the tree sparrow being familiar examples. Eight or ten are *winter visitors*, such as the great white owl and the red cross-bill, which may or may not appear during the

coldest weather of the season. The remaining 110 are *migrants*; birds which regularly pass through the counties, northward bound in Spring and again southward bound in Autumn. The majority of the water fowl and warblers and a number of sparrows, thrushes and vireos are members of this class.

But few notes concerning the reptilian fauna were secured. The prairie rattlesnake still exists in small numbers; and probably 15 kinds of harmless snakes occur in the two counties. Among the sand dunes the six-lined lizard, *Cnemidophorus sexlineatus* (L.), was quite common. They scampered swiftly from one clump of grass to another; so swiftly, in fact, that a great deal of maneuvering was necessary to capture one with a butterfly net. This species has been heretofore considered rare in Indiana, having been recorded only from Knox and Monroe counties. The four varieties of lizard mentioned by Ball* were probably salamanders, since he states that they live in dark cellars. Ten or more species of this group probably occur in the counties. They can be readily told from lizards by their having the skin smooth instead of covered with scales. They also pass through a larval (tadpole) stage, while the lizard undergoes no such change. Sixty or more species of fish doubtless occur in the streams and lakes of the area.

NOTES ON THE FLORA OF LAKE AND PORTER COUNTIES.

While engaged in gathering data concerning the surface geology, notes were taken and specimens secured of a number of the scarcer and more characteristic plants of the two counties, especially those of the Calumet area, and the immediate margin of Lake Michigan. For the most part these notes pertain only to such plants as were in bloom in July and September, and to those whose distribution in Indiana is restricted to this region of the State. But little attention was given to the forms common to the entire State, as it is impossible for any one to gather data for anything like a complete flora of such an area, unless he is able to spend the greater part of several seasons in careful investigation.

The flora of the sand dune area is especially interesting and has been studied in the past by Rev. E. J. Hill, of Englewood, Ill., who has found there a number of species not elsewhere recorded from Indiana. Messrs. Higley and Raddin, in their "Flora of Cook County, Illinois, and a part of Lake County, Indiana,"† have published the results of much of Mr. Hill's work, as has also Stanley Coulter in the Proceedings of the Indiana Academy of Science for 1895.

* Lake County, 1891, 155.

† Bull. Chic. Acad. Sci., II, No. 1, 1891. This paper included the flora of that portion of Lake County lying north of the Little Calumet River. Reference to the paper in these notes will be by the initials H. & R.

A person interested in botany, and living in easy reaching distance of this area, could render a valuable aid to science by preparing a special paper, based on a number of years of observation on the variations, habitat and insect visitors of the different species of plants growing on the sand covered area along the south shore of Lake Michigan.

The nomenclature and order of the following list is that of Gray's Manual of Botany, sixth edition.

ANNOTATED LIST OF PLANTS.

Ranunculus pennsylvanicus L. f. Bristly Crowfoot.

Frequent along the borders of a marsh near Tolleston. July 29. Has been noted only in the northwestern part of the State.

Coptis trifolia Salisb. Goldthread.

Borders of a marsh near Calumet River, northwest of Miller's. In fruit. Recorded from Berry Lake and Pine Station by H. & R., and from the "Knobs" in the "Catalogue of the Plants of Indiana."

Asimina triloba Dunal. Common Pawpaw.

The pawpaw was noted as frequent in several wooded tracks in Jackson Township, Porter County, but not elsewhere in the area. It is not mentioned by H. & R., being partial to open woods in rich soil and not growing in sandy soil nor in prairie regions.

Sarracenia purpurea L. Pitcher Plant. Side-saddle Flower.

Common in a peat bog on the Hayward farm, one mile east of Merrillville, Lake County. This bog is noteworthy from the fact that a thicket of white pines (*Pinus strobus* L.) surrounds it, instead of the tamarack (*Larix americana*), which one would expect.

Cakile americana Nutt. American Sea-Rocket.

North of Miller's and Dune Park in the bare sand, within 200 yards of the lake margin. Often the only herb present on the areas in which it grows.

Hudsonia tomentosa Nutt. Woolly Hudsonia. Poverty Grass. False Heather.

Sand ridges north of Dune Park. Recorded by H. & R. from Pine Station, Miller's and along the ridge from Tolleston to Miller's. Grows in low, densely matted tufts. The leaves are closely appressed, and in late summer or autumn the plant resembles a dwarfed evergreen.

Lechea major Michx. Hairy Pin-weed.

Sandy margin of marsh near Tolleston. July 29. Known in the State only from Lake and St. Joseph counties.

Lechea minor L. Thyme-leaved Pin-weed.

Border of marsh north of Dune Park, September 7.

Hypericum prolificum L. Shrubby St. John's-wort.

Abundant along borders of swamps east of Whiting, within one-fourth mile of lake front. In flowering prime July 27.

Vitis labrusca L. Northern Fox Grape.

Frequent on the sandy, wooded "islands" of the Kankakee valley.

Vitis rupestris Scheele Sand Grape. Sugar Grape.

Grows abundantly on the top and sides of the highest sand ridges near Miller's and Dune Park. A southern form not before recorded from Indiana, the manual range being "Mo. to Tex., Tenn. and southern Penn." The fruit is larger and in more compact, rounded bunches than either that of the frost grape, *V. cordifolia* Michx., or the summer grape, *V. aestivalis* Michx. The leaves are also smaller and the vine spreads over the ground or low bushes, instead of climbing high, even where trees or tall shrubs are present.

Rhus typhina L. Staghorn Sumach.

Sides of sand ridges north of Miller's; scarce. Before recorded from Gibson and Posey counties.

Rhus copallina L. Dwarf Sumach.

Borders of marsh north of Tolleston. This form is probably more widely distributed through the State than the above, though neither is anywhere near so common as *R. glabra* L.

Rhus canadensis Marsh. Fragrant Sumach.

Grows in dense clumps along the lake shore, 100 yards or more from the margin of the water, east of Whiting to Brimson, near Miller's, etc. Much smaller and less spreading than on the rocky hillsides of Monroe and Crawford counties. For its distribution in the State see Proc. Ind. Acad. Sci., 1896, 137.

Polygala cruciata L. Marsh Milkwort.

Common along the borders of marshes north of Dune Park. Recorded also by H. & R. from near Hammond. The flowers vary from purple to pure white.

Baptisia leucantha Torr. & Gray. White False-Indigo.

Prairies and borders of copses; common throughout the central region of both counties.

Lupinus perennis L. Wild Lupine.

Crests of high wooded sand dunes, northeast of Miller's. In fruit July 28.

Amorpha canescens Nutt. Lead Plant.

Road sides in prairie regions; common.

Petalostemon violaceus Michx. Violet Prairie Clover.

Prairies and sand dunes; frequent.

Tephrosia virginiana Pers. Goats-Rue. Catgut.

Dry sandy hillsides; common in Calumet region north of Miller's, etc.

Lespedeza capitata Michx. Round-headed Bush Clover.

Low sandy soil north of Dune Park; frequent.

Lathyrus maritimus Bigelow. Beach Pea.

Sands along the beach of Lake Michigan, east of Whiting; frequent.

In flower and fruit July 27.

Prunus americana Marshall. Wild Plum.

Common on the beaches of old Lake Chicago and on the sand islands of the Kankakee valley.

Prunus pumila L. Dwarf Cherry. Sand Cherry.

Common in clumps along the sand ridges 100 feet or more from the water margin of Lake Michigan and extending back one-fourth of a mile or more. The fruit is very abundant, and when fully ripe is quite palatable, much more so than that of the next two species. Specimens bearing fruit vary in height from two to six feet.

Prunus pennsylvanica L. f. Wild Red Cherry.

A tall shrub or small tree which occurs sparingly along the sand ridges near Brimson and north of Miller's.

Prunus virginiana L. Choke Cherry.

Rather frequent along the sandy margins of swamps near Tolleston, etc.

Spiraea salicifolia L. Meadow Sweet.

Common in low, damp prairies.

Spiraea tomentosa L. Hardhack. Steeple-bush.

With the above, but much less common.

Physocarpus opulifolius Maxim. Nine-bark.

Swampy woods and banks of streams; frequent north of Miller's, Pine Station, etc.

Potentilla fruticosa L. Shrubby Cinquefoil.

A single clump, one mile east of Whiting in sandy soil, 100 yards from lake shore.

Pyrus arbutifolia melanocarpa Michx. Black Chokeberry.

Margin of swamp near Tolleston. Leaves larger, smoother beneath, and more rounded than in the typical form. Not before recorded from the State.

Parnassia caroliniana Michx. Grass of Parnassus.

Low moist grassy places; frequent.*

* For range in State see Proc. Ind. Acad. Sci., 1896, 1:36.

Ribes floridum L'Her. Wild Black Currant.

Frequent on a sandy wooded "island" in the S. E. part of Lake County. Not before recorded in the State north of Jefferson County.

Hamamelis virginiana L. Witch Hazel.

On sides of wooded sand dunes northeast of Miller's; scarce.

Lythrum alatum Pursh. Loosestrife.

Low damp prairies and marshes; frequent north of the Calumet.

Ludwigia polycarpa Short and Peter. False Loosestrife.

Abundant in swales near Tolleston. Before recorded from "Knobs," and Gibson and Vigo counties.

Opuntia rafinesquii Engelm. Prickly Pear Cactus.

Common on the low sand ridges of the Calumet region, growing where nothing else will. Flowers large and handsome.

Eryngium yuccifolium Michx. Rattlesnake Master. Button Snake-root.

Borders of damp prairies and roadsides; frequent south of the Calumet in both counties.

Nyssa sylvatica Marsh. Black Gum. Sour Gum. Pepperidge.

Sand ridges and islands; also on north margin of Cedar Lake; frequent.

Mikania scandens Willd. Climbing Hemp-weed.

Found in abundance covering the button-bush (*Cephalanthus occidentalis* L.) and other shrubs growing in the low ground 50 feet south of the wagon bridge across Sandy Hook Creek, five miles east of Hebron, Porter County, September 21. Before recorded in Indiana only from Gibson County. Manual range—"E. New Eng. to Ky. and southward."

Liatris scariosa Willd. Button Snakeroot.

Sand ridges near Dune Park; frequent.

Liatris spicata Willd. Blazing Star.

Margin of marshes and damp prairies; frequent.

Solidago ohioensis Riddell. Ohio Golden-rod.

Border of marsh near Dune Park, September 7. Known in the State only from Tippecanoe and Lake counties.

Aster nove-angliae L. New England Aster.

Common along roadsides in the central and southern portions of the two counties. One of the largest and most handsome of the asters, its numerous violet-purple rays quickly attracting the attention and admiration of the observer.

Aster sericeus Vent. Silky Aster.

Low sandy soil north of Dune Park; scarce. Not mentioned in the

State Catalogue, and, as far as known, not before definitely recorded from the State, though H. and R. mention it as frequent, without accrediting it to Indiana. Heads large and showy.

Aster polyphyllus Willd.

Borders of marshes north of Dune Park; scarce. Recorded from near Whiting by Coulter, loc. cit. p. 190.

Aster linariifolius L. Double-bristled Aster.

Sandy ridges north of Miller's and Dune Park. Readily known by the shortness of the stems, which grow in clumps from a woody base, and by the rigid linear leaves and showy heads.

Silphium laciniatum L. Rosin-weed. Compass-plant.

A typical prairie plant, yet common along the roadsides and on the upland prairies, especially in Lake County. The large, vertical and pinnately parted, radical leaves resemble somewhat those of the sensitive fern, *Onoclea sensibilis* L. The upland prairie hay formerly contained large numbers of these plants, which served the buyer in distinguishing it from the lowland hay. The former was considered the more valuable, and it is said that some farmers were in the habit of harvesting the compass-plants and afterwards mixing them with the lowland hay in order that it might be mistaken for that from the upland, and so bring a higher price.

Silphium terebinthinaceum L. Prairie Dock.

In similar localities, but more common than the last species, and readily distinguished by its large, undivided root leaves.

Silphium perfoliatum L. Cup Plant.

Sides of ditch near Dyer, Lake County. Not noted elsewhere.

Lepachys pinnata Torr. & Gray.

Roadsides and margins of prairies in Lake County; scarce. Leaves very rough.

Helianthus occidentalis Riddell.

Rather common in dry upland prairies and along sandy ridges.

Artemisia caudata Michx. Wormwood.

Side of sand ridge north of Dune Park; scarce. September 9. For the only previous State record of this and the next species, see Proc. Ind. Acad. Sci., 1895, p. 191.

Artemisia canadensis Michx. Hoary Wormwood.

North of Miller's at foot of sand ridge; scarce. September 8.

Oniscus pitcheri Torr. Pitcher's Thistle.

Sides of the highest sand ridges and dunes north of Miller's. In fruit, July 27. Known in the State only from Lake County.

Oniscus arvensis Hoffm. Canada Thistle.

This well known pest has undoubtedly gotten a foothold in northern Indiana, which will be troublesome to overcome. Numerous large patches were seen along the railways of the Calumet region, and a half acre or more flourished undisturbed near the center of the city of Hammond. Isolated specimens were also noted near Cedar Lake and other localities. It may be readily distinguished by its numerous small heads, which are less than half the size of those of the common thistle; also by its slender stem and upright flowering branches. It is seldom more than eighteen inches in height.

Lobelia kalmii L. Kalm's Lobelia.

Margin of low grassy pond north of Miller's, July 27. Frequent.

Campanula aparinoides Pursh. Marsh Bellflower.

Wet, grassy meadows; common. This and the preceding species occur, as far as known, only in the northern third of the State.

Gaylussacia resinosa Torr. & Gray. Black Huckleberry.

Common in the sandy soil along the borders of marshes in the Calumet region, especially in Lake County.

Vaccinium pennsylvanicum Lam. Dwarf Blueberry.

Common on the sand ridges and dunes in the northern third of both counties.

Vaccinium vacillans Solander. Low Blueberry.

Dry, sandy hills north of Miller's; scarce.

Vaccinium corymbosum L. Swamp or High Blueberry.

Margin of marshes in the Calumet region; common. Grows to a height of six to eight feet, and produces the blue huckleberry of the latter part of the season.

Vaccinium macrocarpon Ait. American Cranberry.

Noted growing wild only in the peat bog one mile east of Merrville, though doubtless occurs in numerous places in the swampy area of the Calumet region, which is well adapted to its cultivation. Much of the waste land of this area could be profitably put to that use.

Arctostaphylos uva-ursi Spreng. Red Bear-berry.

Sides of sand ridges within 100 feet of the lake shore east of Whiting and north of Miller's. In fruit July 28. Occurs only in the counties bordering on Lake Michigan.

Gaultheria procumbens L. Creeping Wintergreen. Checkerberry.

Abundant around the borders of a marsh northeast of Tolleston; also sparingly near Dune Park. It has also been taken by the writer at the Pine Hills, Montgomery County, but does not occur in Monroe County, as stated in the catalogue of Indiana plants.

Cassandra calyculata Don. Leather Leaf.

Margins of swamps east of Whiting, north of Miller's and near Dune Park; frequent. Occurs also abundantly in the tamarack swamps near DeLong, Marshall County.

Chimaphila umbellata Nutt. Prince's Pine. Pipsissewa.

High wooded sand dunes northeast of Miller's; scarce. In fruit July 28.

Asclepias verticillata L. Whorled Milkweed.

Sand ridges near the railways east of Whiting; frequent.

Acerates viridiflora Ell. Green Milkweed.

With the above, but scarce. In flower July 27.

Sabbatia angularis Pursh. Bitter-bloom. Rose pink.

Common about the margins of low, grassy meadows. One of the most handsome of our midsummer wild flowers. Occurs probably throughout the State.

Gentiana crinita Froel. Fringed Blue Gentian.

Borders of marshes north of Miller's and Dune Park. September 8 and 9. Occurs in suitable localities throughout the northern half of the State.

Veronica scutellata L. Marsh Speedwell.

Slough north of Tolleston; July 29; scarce. Recorded only from Steuben and Noble counties.

Gerardia purpurea L. Purple Gerardia.

Abundant in low, damp meadows, both in the Calumet region and the Kankakee Valley.

Pedicularis lanceolata Michx. Lanceolate-leaved Lousewort.

Borders of marshes north of Dune Park; scarce.

Utricularia vulgaris L. Greater Bladderwort.

Scarce in marshes north of Miller's, between the Calumet and the Lake Shore; July 28.

Utricularia cornuta Michx. Bladderwort.

With the above but much more frequent; also Sep. 8. *U. gibba* L.; *purpurea* Walt., and *resupinata* Greene, are also recorded from near Miller's in the H. & R. list, but no specimens were seen during my visit to that locality.

Monarda punctata L. Horse Mint.

This is one of the prevailing plants in all the sandy region north of the Kankakee, being as common in the streets and on the sandy ridges as is the dog fennel, *Anthemis cotula* DC., in the central part of the State.

Cycloloma platyphyllum Moquin. Winged Pigweed.

Sandy shore of Lake Michigan, east of Whiting and north of Dune Park; frequent. The first record for the State.

Salsola kali tragus L. Saltwort. Russian Thistle.

Found sparingly in loose sand within 100 yards of the margin of the lake, between Whiting and Dune Park. Is liable to spread and prove a very troublesome weed.

Euphorbia corollata L. Flowering Spurge. White Spurge.

One of the most common and characteristic plants of the sand covered area of the two counties. Noted here only because of its abundance.

Myrica asplenifolia Endl. Sweet Fern.

Noted just west of the station of Highland, where it was common in the sandy soil on the south slope of Calumet Beach. Recorded from Miller's by Coulter—Proc. Ind. Acad. Sci., 1895, 195. These are the only two records for the State.

Betula populifolia Ait. White Birch.

Sand ridges west of Miller's; scarce.

Betula papyrifera Marshall. Paper or Canoe Birch.

More frequent than the above. Not found more than three miles back from the lake, and not noted in Porter County. Most of the trees close to the lake have been killed by fire.

Betula nigra L. River or Red Birch.

Common along the banks of the Kankakee. Recorded in the Catalogue of Indiana Plants only from Gibson County, but has been noted by the writer in Martin, Vigo, Owen, Jackson, Putnam, Marion and Lake, so that it probably occurs throughout the western two-thirds of the State.

Betula pumila L. Dwarf Birch.

Borders of swamps north of Tolleston; common.

Alnus incana Willd. Speckled or Hoary Alder.

Banks of Calumet north of Miller's; frequent. Known in the State only from Lake County.

Salix glaucophylla Bebb. Broad-leaved Willow.

Sand ridges near the Calumet, north of Miller's; frequent.

Pinus banksiana Lambert. Gray or Northern Scrub Pine.

Sand dunes and ridges within three miles of the lake shore, between Whiting and Michigan City; common. Specimens 40 to 60 feet high were plentiful.

Juniperus communis alpina Gaud. Low Juniper.

This form is recognized by Britton & Brown* as a distinct species under the name of *Juniperus nana* Willd. It occurs sparingly north of Miller's on the sand ridges, forming dense circular masses six to ten feet

* Illustrated Flora, I., p. 60.

in diameter, with the individual stems about two feet high and recurving or depressed. The leaves are shorter and more numerous and the berries larger than those of the common *J. communis*. The latter is widely distributed over the State, while the one under consideration is a northern and eastern form not before recorded from within its bounds.

Spiranthes cernua Richard. Ladies Tresses. Screw Stem.

Borders of low damp meadows; frequent in the Calumet region.

Habenaria ciliaris R. Br. Yellow Fringed Orchis.

Frequent about the borders of a marsh northeast of Tolleston, July 29. In a paper entitled the "Distribution of the Orchidaceæ in Indiana,"* Miss A. M. Cunningham gives the known State records of this species as St. Joseph, Noble and Steuben counties. I have found it in numbers also at DeLong, Marshall County.

On account of the lateness of the season the above were the only two orchids seen by me in the counties, though H. & R. record *Liparis læselii* Rich., *Aplectrum hyemale* Nutt., *Corallorhiza innata* R. Br., *C. multiflora* Nutt., *Goodyera pubescens* R. Br., *Arethusa bulbosa* L., *Pogonia pendula* Lindl., *Habenaria tridentata* Hook., *H. virescens* Spreng., *H. bracteata* R. Br., *H. hyperborea* R. Br., *H. hookeri* Torr., *H. lacera* R. Br., *H. psycodes* Gray, and *Cypripedium spectabile* Swartz, from definite localities in Lake County, besides mentioning ten additional species as being found southeast of Chicago, in the territory covered by their list, without giving localities.

Aletris farinosa L. Colic Root. Star Grass.

Sandy soil near border of marsh north of Tolleston; scarce.

Smilacina stellata Desf. Star Flowered Solomon's Seal.

Very common on the "sand islands" of the Kankakee Valley, and the barrens of the Calumet region. I have never met this species in central or southern Indiana, though I have studied the plants of those regions for ten or more years.

Lilium philadelphicum L. Wild Orange-red Lily.

Borders of prairies; scarce. One specimen north of Cedar Lake, July 11.

Tofieldia glutinosa Willd. False Asphodel.

Margin of a swale, north of Miller's; July 28; scarce. Known in the State only from Lake, Fulton and Noble counties.

Commelina virginica L. Virginia Day-flower.

Frequent on the side of wooded sandy hills, northeast of Miller's.

Triglochin maritima L. Arrow Grass.

Shallow water of marshes north of Miller's; frequent, July 28. Recorded before in Indiana only from near East Chicago.

* Proc. Ind. Acad. Sci., 1895, 201.

Cyperus filiculmis Vahl. Slender Cyperus.

Side of sand hills at Dune Park; frequent. Known in the State only from Lake and Porter counties.

Cyperus houghtoni Torr. Houghton's Cyperus.

Side of sand ridge near Tolleston, July 29. The first record for the State, the manual range being "Mass. to Minn., Kans. and Oregon" A handsome species with the plumes two feet or more tall, the spikes numerous and densely flowered.

Panicum autumnale Boec. Diffuse Panicum.

Frequent along sides of the sand ridges in the Calumet region. Grows in dense tufts. The panicle much branched and spreading, and of a handsome purplish tinge. Recorded only from Lake and Vigo counties, but has been noted, by the writer, also in Jasper and Starke.

Zizania aquatica L. Indian Rice. Wild Rice.

Shallow water of marsh north of Miller's; scarce.

Ammophila arundinacea Host Sand-Reed.

Frequent on crests of the higher sand ridges and dunes all along the lake shore. The spike-like panicle eight to twelve inches in length and quite handsome.

Phragmites communis Trin. Reed.

One of the tallest members of the grass family, sometimes reaching a height of eighteen feet. Grows in dense isolated patches in the sloughs and swamps of the Calumet and Kankakee regions.

* * *

The 103 species above recorded comprise probably less than one-tenth of the flowering plants of the two counties, being only such as were especially noted or collected as I passed hurriedly from place to place. Higley and Raddin give definite localities for about 400 additional species in Lake County, many of which occur nowhere else in Indiana.

There is no better place for an extended botanical study of a limited area in the State than among the dunes, swamps, peat bogs, prairies and river bottoms of this area, and it is to be hoped that some one with leisure and ability will, before it is further modified by man, make a complete and permanent record of its flora.

ELEVATIONS.

A list of elevations of a number of points in the two counties is here given. It has been compiled from the following sources:

Gannett's Dictionary of Altitudes; Campbell's Survey of the Kankakee Region; data furnished by Henry Rankin, Ex-County Surveyor of Porter County; by Geo. Fisher, County Surveyor of Lake County, and by Frank Leverett.* The initials "G.", "C.", "R.", "F." and "L." after the location refer, respectively, to the authority cited.

ALTITUDES IN LAKE COUNTY.

Creston, railway—L.....	740	feet.
Crown Point, C. & E. Railway—G.....	702	feet.
Crown Point, Court House yard—F.....	714	feet.
Crown Point, Panhandle Railway at station—F.....	695	feet.
Dyer, M. C. Railway—G.....	638	feet.
Fancher Lake, surface of water August, 1896—F.....	713	feet.
Griffith, railway crossing—G.....	636	feet.
Hammond, M. C. Railway—G.....	595	feet.
Hammond, Nickle Plate Railway—G.....	598	feet.
Hessville, railway—G.....	623	feet.
Highland, railway—G.....	617	feet.
Hobart, P. F. W. & C. Railway—L.....	622	feet.
Kankakee River, old mouth of Eagle Creek—L.....	+660	feet.
Kankakee River, surface of water at Monon Railway bridge		
—C.....	635.7	feet.
Kankakee River, surface of water at State Line—C.....	624.3	feet.
Lake Michigan, mean surface level—G.....	582	feet.
Leroy, railway—L.....	683	feet.
Little Calumet Marsh, sections 16 and 21 (36 north, 9 west)—L.....	505	feet.
Liverpool, M. C. Railway—G.....	627	feet.
Lowell, railway—L.....	690	feet.
Miller's, L. S. & M. S. Railway—G.....	625	feet.
Palmer, railway—L.....	733	feet.
Ross, M. C. Railway—G.....	638	feet.
Schererville, railway—L.....	644	feet.
Shelby, railway crossing—C.....	642	feet.
St. Johns, railway—L.....	697	feet.
Watershed, near head waters of Eagle Creek and Deep River—L.....	747	feet.

* In sending his data Mr. Leverett wrote as follows: "I send some elevations which I obtained from Mr. Gannett last winter, some of which I do not think appear in his Dictionary of Altitudes. Some are slightly different from the altitudes given in his Dictionary because of a revision which he has made in the light of fuller data. I have also inserted a few aneroid determinations which I made in Porter County. To those I have affixed the + sign."

† This level is from the report of the U. S. Deep Waterways Commission, below cited.

‡ The standard low water elevation of Lake Michigan as given by the U. S. Deep Waterways Commission for 1896 is 579.60 feet, and the high water elevation is 584.31 feet.

ALTITUDES IN PORTER COUNTY.

Chesterton, L. S. Railway—L.....	659	feet.
Chesterton, L. S. Railway—R.....	670	feet.
Coburg, B. & O. Railway—G.....	786	feet.
Coburg, B. & O. Railway, at summit—G.....	795	feet.
Crest of Moraine in section 35 (36 north, 6 west)—L.....	825 +	feet.
Crest of Moraine in section 11 (35 north, 6 west)—L.....	840 +	feet.
Crissman, railway crossing—L.....	645	feet.
Flint Lake, surface of water—R.....	825	feet.
Furnessville, railway—L.....	670	feet.
Gossett's Mill Pond, south end; northwest quarter of section 28 (36 north, 6 west)—L.....	620 +	feet.
Hebron, Panhandle Railway—L.....	713	feet.
Kankakee River, Dunn's bridge, surface of water—C.....	663.7	feet.
Kankakee River, Grand Junction, surface of water—C.....	660.5	feet.
Kankakee River, Baum's bridge, surface of water—C.....	659.4	feet.
Kouts, railway crossing—L.....	687	feet.
Liberty Township, east line, point of crossing B. & O Railway —L.....	687	feet.
Morgan Prairie, northwest quarter of section 36 (35 north, 5 west)—L.....	758	feet.
Old shore of Lake Chicago Bay, west of Wheeler, northeast quarter of section 3 (35 north, 7 west)—L.....	640 +	feet.
Old shore of Lake Chicago Bay, southeast quarter of section 28 (36 north, 6 west)—L.....	650 +	feet.
Porter, M. C. Railway—R.....	668	feet.
Salt Creek, crossing of P. F. W. & C. Railway bridge—L.....	650 +	feet.
Sandy Hook Creek, crossing of Panhandle Railway—L.....	673	feet.
Summit, near center of section 30 (36 north, 5 west)—R.....	888	feet.
Valparaiso, G. T. Railway—R.....	820	feet.
Valparaiso Court House yard—R.....	803	feet.
Valparaiso P. F. W. & C. Railway Station—L.....	736	feet.
Wheeler, P. F. W. & C. Railway—L.....	665	feet.
Woodville, B. & O. Railway—R.....	721	feet.

* * *

In the preparation of the foregoing paper on the Geology of Lake and Porter counties, I have been aided by a number of persons to whom acknowledgments are due. To Mr. Frank Leverett, of Denmark, Iowa, I am under special obligations for the use of notes pertaining to the physiography of the Calumet region—and for data used in the preparation of the accompanying map. Rev. T. H. Ball and Hon. J. W. Youche, of Crown Point; Mr. A. F. Knotts, of Hammond, and Mr. Henry Rankin, of Valparaiso, also furnished me much data; while Mr. Rankin, Herbert Ball of Crown Point, Hon. Jerome Dinwiddie of Hebron, Hon. Geo. C. Gregg of Hobart and E. L. and Hon. L. G. Furness of Furnessville accompanied me for a portion of the time during my researches throughout the area, and aided me in securing much data which might otherwise have escaped my attention.

THE CLAYS AND CLAY INDUSTRIES OF NORTH- WESTERN INDIANA.

BY W. S. BLATCHLEY.

During the past five years the clay industries of Indiana have had a steady growth. The ever increasing demand for clay products for structural and road uses has been the chief incentive to this growth. The rapid advancement in the price of lumber, due to the disappearance of the forests of the State, has led architects and builders to investigate more carefully than ever before the advantages of clay products for structural purposes. These investigations have, for the most part, proven satisfactory, and have shown the unexcelled fitness of such products for many uses to which stone, wood or other materials were previously put.

As a proof that the general public is beginning to appreciate this fitness, one has but to note the rapidly increasing use of terra cotta and pressed brick for the fronts of business blocks and the more fashionable and costly private residences; of hollow brick for their partition walls; of flue linings for their chimneys; of clay shingles for their roofs, and of encaustic tiles for their floors and mantels. Indeed, all present signs point to clay—that most widely distributed and cheapest resource known on earth—as the leading factor in the future structures built by man.

Nor has the increased demand for clay products been confined to those used for building purposes. The use of vitrified products, such as sewer pipe and paving brick, and refractory clay wares such as fire brick and furnace linings, has also been constantly growing. To supply these increased demands new industries have sprung up in many portions of Indiana, and new discoveries have been made concerning the practical uses of many deposits of clay before considered worthless. Meanwhile, constant inquiries for literature relative to the clays of the State have been received at the office of the Department of Geology. To meet this demand for literature, the writer, in 1895, made a careful study of the clay deposits of the coal-bearing

counties in southwestern Indiana, and a detailed paper concerning them was published in the Annual Report of the Department for 1895.

In that paper it was shown that with the exception of some of the clays used in making the better grades of terra cotta, encaustic tile and china ware, Indiana has within her coal-bearing counties the raw material in abundance for making every kind of clay product used within her borders. Some of the best clay deposits and the largest clay factories of the State are, however, located in the northwestern counties, and a portion of the time of the writer during the field season of 1897 was spent in the study of the clays of that region. The results of that study are incorporated in the present paper.

It is difficult to give an accurate definition of the term "clay," as commonly used. In general, the name is applied to any soft, earthy substance which, when wet, can be readily fashioned into any desired

Definition of Clay. shape, which shape it will retain while being dried or burned. All clays are, however, not soft. Many of the

best clay deposits of the State are hard, rock-like substances, which must be blasted and ground into powder, before being used. Such clays are either shales or fire-clays. The shales are only clays which, many centuries ago, were deposited in deep water. By pressure they have since become consolidated and separated into rather thin layers or laminæ. A shale is therefore only a hardened, laminated clay. The fire clays are the under-clays of the coal veins. At one time they formed the soil from which sprung the luxuriant plant growth which was afterwards changed into coal. Those plants removed from that soil many of the elements now found in shales and clays, and as a result articles made from fire-clays are more refractory; i. e., will withstand far greater heat without melting, than will those made from shales or ordinary soft clays.

According to the chemist, pure clay is a "hydrated silicate of alumina," the formula of which is $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$. This simply means that two atoms of the element aluminum, two of silicon and seven of oxygen are united into a molecule of the compound, silicate of alumina, and that that molecule is combined with two molecules of water, to form the clay. Pure clay, with the above composition, is called *kaolin*. Most clays are, however, impure and contain numerous other compounds mixed with their kaolin. The kaolin, called the "clay base," is present in all material to which the term clay rightfully belongs. The purer the clay the greater the amount of kaolin which it contains.

Many inquiries are made concerning "aluminum clay." From the above it will be seen that all clays contain aluminum in greater or less

quantities. All clays are, therefore, aluminum clays. The metal aluminum is not, however, separated from a clay, but from a compound called bauxite, which differs from a pure clay in that its aluminum is combined with oxygen to form a soluble oxide instead of with silicon and oxygen to form an insoluble silicate. Bauxite occurs in Alabama, Arkansas, and other Southern States, but not in Indiana.

The clay base or kaolin in all clays had its origin in the decomposition of granite or other primitive rocks which contained feldspar.

Origin of Granite is composed of three minerals: quartz, mica and
Clays. feldspar. Quartz or silica is wholly insoluble in rainwater or ordinary acids. Mica is also as insoluble as quartz. The

feldspar of granite is composed of a silicate of potash which is soluble combined with a silicate of alumina which is insoluble, and this combination acts as a cement. Granite, then, may be regarded as composed of particles of insoluble quartz, united to particles of insoluble mica by a cement called feldspar which is partially soluble and partially insoluble.

When the granite of the first crust of the earth was exposed for centuries to the air and water, the oxygen of the former and the carbonic and other acids in the latter, acted in time upon the feldspar or cement. As the water percolated through the granite which had been softened by long exposure to the air, the carbonic acid united with the potash of the feldspar to form a carbonate of potash very soluble in water. The feldspar or cement was thus destroyed and the granite crumbled. From it resulted a mass of kaolin (the insoluble silicate of alumina of the feldspar) mixed with quartz particles or sand and numerous scales of mica. This resulting kaolin now forms the clay-base, or essential part of all clays. Besides granite, syenite, gneiss and other primitive rocks contained much feldspar, and by a similar decomposition as that noted have yielded their proportion of kaolin. The latter is, therefore, simply one of the kinds of matter resulting from the decay of feldspathic rocks.

VARIETIES OF CLAYS.

When the clay remains in the place where it has been formed it is called a *residual clay*. When it has been carried by water, ice or other agency to a new location and redeposited in water it is called a *sedimentary clay*. Ninety per cent. of the clays of Indiana belong to the latter group. Among the sedimentary clays are the shales, above mentioned, which were deposited in deep water, and the fire-clays, deposited in the more shallow lagoons and swamps in which the coal plants grew. In the area considered in the present paper, all the clays

are sedimentary and most of them are soft clays, belonging to one of three subdivisions: namely, drift clays or "hard pans;" alluvial clays, and silty or marly clays.

The drift clays or hard pans are by far the more common clays in northwestern Indiana. They form a very large percentage of the unstratified morainic material or till which was dropped where it now

Drift Clays lies by the melting of one or more of the great ice sheets or glaciers which many centuries ago invaded Indiana.*

or
Hard Pans. Transported and deposited as they were, these drift clays are, in general, too impure for any use but the making of ordinary brick and drain tile, and oftentimes they contain too much lime even for this purpose, numerous analyses showing the presence of as high as 40 per cent. of calcareous material. This is due to the grinding up and mixing with the clays much of the surface limestones over which the glacier passed, as the erosion of that epoch not only removed and commingled the previously formed residual deposits, but planed away the country over a vast area to a greater depth than had been reached by any previous decay. These eroded limestones and the clays with which they were mixed were many of them ground into impalpable powder and deposited before a subsequent decay could take place, so that, as has been well said, "the drift clays are, many of them, rock flour, and not, as are the residual clays, the products of rock rot."†

Along the lowlands and second bottoms of the larger streams of northwestern Indiana are found, at intervals, very large deposits of alluvial clays. These are sedimentary clays of the present age. They owe their origin either to the deposition of fine particles of clay in the eddies of the streams, or to the slow accumulation of the clayey sediment

Alluvial during the annual overflows of the areas which they now
Clays. occupy. In some places they are 30 to 90 feet in thickness and remarkably free from pebbles or coarse impurities of any kind. They are usually very plastic owing to the presence of salts of lime and iron oxides which are intimately diffused through them.

Silty or marly clays resemble very closely alluvial clays. They differ in that they were deposited in bays, lakes or harbors, by still
Silty instead of by flowing water. Much "rock flour" contain-
or Marly ing a large percentage of kaolin was produced by the
Clays. passing of the glaciers over beds of shale. This was held in suspension by the glacial streams and finally deposited

* For a more extended account of one of these ice sheets see p. 30 of this volume.

† Chamberlain, T. C.—Sixth Ann. Rept. U. S. Geol. Surv., p. 249.

in the bays and lakes of that epoch. These marly clays are, in general, composed of finer grains, and are more usually in thin layers, separated by a coating of sand, than are the alluvial clays. They contain a greater percentage of finely disseminated lime and magnesium carbonates, and for that reason products burned from them are usually cream colored or whitish.

The beds of sedimentary clay now found upon the surface of Indiana are very few of them identical with those first formed after the decay of the primitive crystalline rocks. That igneous force which somewhere is ever pushing the bottom of the sea upward, long ago raised the first shale beds into dry land. Rain and frost again caused their decay, and again did the agency of flowing water mix and grind and bear their particles to the bottoms of new seas and lakes. No one knows, or can ever know, how often these successive changes of elevation, disintegration, erosion and deposition have taken place in the ages past; but the clay-base in the materials of our buildings and roadways of to-day, would, if traced backwards, lead us through many a geologic change to the granites and gneisses of the old archæan times.

PROPERTIES OF CLAYS.

All clays suitable for manufacturing purposes possess certain essential and characteristic properties which will now be briefly considered. The most important of these is plasticity. It is this property which causes clay, when mixed with water, to become a tough, pasty mass

Plasticity. readily capable of being fashioned into any form by the hands or molds. This plasticity is due to several causes, chief among which is the presence of the water combined with the silicate of alumina in the formation of the clay. When the clays are once burned and this combined water driven off by heat, they lose their plasticity. Brick dust or burned clay may be ground fine and moistened, but unless mixed with some unburned plastic material the particles will not cohere. The absence of crystals in the clay-base or kaolin also adds greatly to the plasticity of the clay, as does also the fineness to which the grains of kaolin have been reduced. Clays which are mixed in autumn and "weathered"—i. e., exposed to rain and frost throughout the winter, have the crystalline structure of their kaolin more or less broken up by alternate freezing and thawing. Their degree of fineness is at the same time increased, rendering them more highly plastic and therefore more readily molded into any desired shape.

A second important property of clay is infusibility or refractoriness. Kaolin and the best grades of fire clay cannot be melted in the highest heat produced by man. This property is very valuable, in *Infusibility.* that it enables clay to be formed into many products used in the structure of fire proof buildings, and in furnaces for the reduction of ores. Most sedimentary clays contain lime, potash, iron and other impurities which weaken the property of infusibility, and cause them to melt or fuse at a comparatively low temperature. Such impurities are called "*fluxes.*" Good grades of fire-clays cannot contain more than three to four per cent. of these fluxes. All sedimentary clays contain a much higher per cent. and for this reason fire bricks, furnace linings, crucibles, retorts, etc., cannot be made from them. Great care must be taken in the burning of wares from such clays, in order to prevent the heat from rising to or above that point where fusion takes place.

A third property of clay is insolubility. The better grades of clay are not affected by any acid or other chemical. On impure clays, *Insolubility.* however, especially those containing much lime, carbonate of iron or allied chemical, muriatic or sulphuric acid will cause an effervescence or bubbling, and the clay will be in part destroyed. This property of insolubility possessed by the raw clay is not lost in the burning and the finished clay product can be brought in contact with acids or chemicals without being impaired.

The fourth and last property of clay to be here mentioned is that of induration. By this is meant the power which it possesses of hardening when subjected to heat. The importance of this *Induration.* property can scarcely be over-estimated. Without it an article fashioned from clay would be only so much stiff mud which on exposure to rain or frost would soon crumble to dust on account of its porosity and attraction for moisture. Almost any clay which possesses plasticity enough to be molded into shape can be baked and thereby made to become hard, solid, and stone-like in appearance.

IMPURITIES OF CLAY.

The uses to which any clay can be put are determined very largely by the impurities which it contains. Anything other than the clay-base or kaolin may be considered an impurity. The impurities most commonly found in clays are silica or sand, compounds of iron, lime, magnesia, potash, soda, and sometimes organic matter.

Of these the most common is silica or sand in a free or uncombined state. It is found in all clays, and though classed as an impurity,

Sand. it is in most instances a necessary constituent, since its presence prevents that warping, shrinking and cracking while drying which is sure to take place in the made-up ware when too great a percentage of pure kaolin is present. Clays which are tough and exceedingly plastic are termed "fat clays," and to them sand is often added artificially to lessen the plasticity and render their products more easily dried. Uncombined silica in moderate quantities is thus beneficial, since it preserves the form at high temperatures. When in excess it destroys cohesion and renders the ware brittle and weak.

Next to sand, compounds of iron are the most common and the most important impurities of clays. The two oxides, ferrous and ferric, the carbonate, and the sulphide are the forms of iron compounds usually occurring, though others may be present.

The oxides of iron have much to do with the colors of clays, both in the raw and burned state. Ferrous oxide—the more common of the two—is found in all drift and alluvial clays, especially those of a bluish or greenish-blue color. When such clays are burned the ferrous oxide is changed to a ferric oxide, which is brownish red, and the wares become the same color.

Besides imparting a color to clay products, the oxides of iron act as fluxes. Especially is this true where from 5 to 15 per cent. of these oxides are present, as in many of the shales and drift clays. Such clays fuse at much lower temperatures than others which are similar in every respect, except in the percentage of iron oxides. The carbonate, sulphide and sulphate of iron, when present, also act as fluxes and are liable to produce a distortion of the brick or other product.

Among the sedimentary surface clays, especially those treated in the present paper, lime and magnesia are always present. If in fine particles, thoroughly disseminated through the clay, they only act as fluxes, and so limit the use of the clay to the making of certain products. Lime, however, more commonly occurs in the drift clays or till, in the form of small grains or pebbles of the carbonate. Unless these can be removed or ground to powder by a crusher, the clays containing them are practically worthless.

Lime and Magnesia. If burned with the clay each lime pebble loses carbon dioxide and is changed from a carbonate to an oxide or quick-lime. This has great attraction for water, and when exposed each pebble absorbs moisture, swells and bursts off a piece of the ware, causing a defect or shallow pit in its surface.

When lime and magnesia are present in quantity in a finely divided state they combine with the oxides of iron and with some of the sand to form a light colored double silicate of iron and lime. For this reason many of the alluvial and marly clays in northwestern Indiana—especially those near Hobart, Michigan City and South Bend—although rich in iron oxide, produce whitish or cream colored instead of red products.

Potash and soda are two of the most powerful fluxes found in clays. They melt at a lower temperature and unite more readily with the clay-base than do iron, lime or magnesia. Their amount is not large,

<i>Potash and Soda.</i>	being, on an average, but 2 to 4 per cent., but in fusing power this is equal to more than double that percentage of the fluxes above mentioned. If vitrified products, such as paving brick and sewer pipe are desired, a total of from
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10 to 14 per cent. of all the fluxes named are necessary in the clay. When the ware is raised to a temperature sufficient to melt the potash, iron, lime, etc., these fluxes fuse with the silica and give to the ware that dense, tough, non-porous condition characteristic of all so-called "vitrified" products.

* * *

On account of office work connected with the issuing and distributing of the 21st Annual Report, I was unable to begin field investigations in 1897 until July 10th. The most of the time thereafter was spent in gathering data for the detailed report on Lake and Porter counties which appears in the present volume. The time left at my disposal for studying the clays of northwestern Indiana was very limited, and the present paper, therefore, deals only with the more important clay deposits of Benton, Newton, Jasper, Starke, Lake, Porter, Laporte and St. Joseph counties.

THE CLAYS AND CLAY INDUSTRIES OF BENTON COUNTY.

Benton County comprises an area of 414 square miles of the most fertile portion of northwestern Indiana. It lies on the western border of the State and is the third county south from Lake Michigan. Its entire surface is a gently rolling prairie broken only by three prominent morainic ridges which run in an easterly and westerly direction across its area. Standing upon one of these ridges near the center of the county one can behold the undulating prairie spreading away in all directions like the billows of the ocean. Timbered groves—*island-like*—dot here and there its surface, and well built farm houses with

surrounding orchards are seen on every side. No finer body of farming land exists in the Mississippi Valley than these rolling plains of Benton County.

The soil is everywhere a rich, black loam, composed of the remains of plants which have decayed under water, and of silt which has been mixed with them by slow deposition. For, after the recession of the great ice sheet which covered the underlying rocks with a thick deposit of boulder clay, all these prairies were covered with shallow lakes, which by natural causes were gradually drained. In the first settlement of the county many of the prairies were too wet for cultivation, and a number of marshes which had not yet reached the stage of "wet prairies" were scattered at intervals within its bounds. To properly drain these wet regions has been the chief problem of the land owners. This has been accomplished by the construction of a great system of surface ditches which ramify throughout every portion of the county. These have necessitated the using of an immense quantity of drain tile. The manufacture of this tile has been the chief, and up to 1896, practically the only clay industry in the county.

The clays of Benton County are all of them of glacial origin. They lie immediately beneath the black prairie loam, and vary in known thickness from 5 to 130 feet. When first deposited by the melting ice these clays were a uniform blue in color. In the course of time, however, the upper portions of the clay beds have been percolated by waters containing humic acids and other substances from the decaying vegetation above. These have changed the ferrous or lower oxide of iron to the ferric or higher oxide. As a result the upper 5 to 20 feet or more of the clay, is now a brownish yellow. There is often a sharp line of division between the yellow, weathered portion and the blue or unweathered part of the clay. The latter is usually the more plastic and the better in quality.

The best deposit of clay in Benton County, so far as known, is the one at Earl Park, on the Chicago Division of the Big Four Railway. It has been worked since 1891 by the Earl Park Elevator and Tile Co., whose works are located about 150 yards from the pit in the south part of the town. A section obtained at the pit showed as follows:

1. Soil—stripped for working..... 8 inches.
2. Coarse-grained yellow clay, with many small
pebbles 4 feet.
3. Fine-grained drab clay..... 8 feet.
4. Blue clay—marly—fine-grained38 feet.
5. Limestone ? ?

No. 2 of this section contains little lime, except what is in the pebbles. It is more refractory than the clays of the lower strata, but the lime and other pebbles must be removed or crushed, else they will spoil all wares produced from it.

The clay of stratum No. 3 is very similar to that of No. 4, except in color. Its lighter hue is due to leaching waters. The sediment of which the two strata are composed was probably deposited in still water by a stream from the retreating ice sheet. They contain an occasional drift pebble, but no large number of small limestone pebbles as does the upper stratum. Both are very fine grained, effervesce freely with acids and are to be classed as marly clays. They probably contain about 8 per cent. of carbonate of lime and magnesia in addition to the other fluxes. For this reason vitrified products of high quality cannot be made from them. Mixed with the upper clay, No. 2, they will withstand more heat. From them alone can be made, however, good pressed front brick, terra cotta lumber, drain tile and ordinary building brick.

The company operating this deposit has been recently reorganized and have put in some good machinery. Before 1896 only drain tile and ordinary brick had been made; the former from a mixture of all the clays, the latter from the two upper strata. They had used only a Pott's disintegrator to separate the pebbles, and a "Little Wonder" stiff-mud brick and tile machine. In that year they put in a 9-foot dry pan for crushing the clays; a Boyd dry press for pressed front brick, and a Boyd steamer to moisten the clay dust, after the latter has passed through two inclined screens. For drying the stiff mud brick and tile they have four floors, each 60x90 feet, heated by steam pipes, and for burning all their wares, four down-draft kilns, each of which hold 40,000 brick.* Hereafter the making of pressed front brick will be carried on to quite an extent. The color of these will depend upon the mixture of the clay, those from the blue clay alone being whitish yellow, and from the other clays different shades of red. At the time of my visit the making of such brick was yet in the experimental stage. Too many different shades were being made and too large a percentage were warped. Experience will doubtless remedy these defects, and with a man who has a practical knowledge of clay manufacturing in charge of the plant, there is no doubt but that its future will be a success.

At Lochiel, on the C. I. & C. Railway, drain tile have been made for a number of years by the Lochiel Tile Company. The material

* For further statistical information concerning this and other factories see table near close of this paper.

used is a stiff, dark colored drift clay which contains numerous small pebbles of lime. It is rather coarse grained and resembles the upper stratum at Earl Park in containing too small an amount of disseminated lime to effervesce with acids. Six inches of soil are stripped and the clay used only to a depth of four feet. It is hauled in carts to the plant and passed through a crusher and then through an Adrian brick and tile machine. Experiments in making pressed brick have been tried, but the brick were too brittle and the clay in general too coarse. Some hollow brick, of good quality for foundation work, have been made at this place. This company formerly produced the second largest output of tile of any in the county. Of late years the demand has fallen off and the production is much less. They have ample dry sheds and three round down-draft kilns of standard size. If the clay be properly crushed a good grade of tile can be made at Lochiel, but the qualities of the clay are not of the best for making other wares.

Drain tile have been made at Fowler, the county seat, by the Fowler Tile Works, since 1883. The material used is a rather coarse grained "hard pan" or "drift clay" very similar to that at Lochiel, but contains a much smaller number of lime pebbles. Five feet of clay are utilized after six inches of soil have been stripped. This clay is passed through a Potts disintegrator and pug mill, then made into tile on a Frees brick and tile machine. The tile are dried in sheds heated with exhaust steam for about one week. They are then water-smoked for 24 hours and burned from 24 to 30 hours. The burning is done in three round down-draft kilns, each capable of holding 15,000 4-inch tiles. The fuel used here, as elsewhere in the county, is slack coal. The clay burns red, but in time there appears on many of the tile a whitish efflorescence. This does not injure the quality of the tile.

The following is the daily capacity of the different sizes of tile made on a Frees brick and tile machine at the Fowler Works, and the price of tile at that place in 1897. Fifteen tile of any size equal one rod in length.

<i>Size.</i>	<i>Daily Capacity.</i>	<i>Price.</i>
3½ inch.....	12,000.....	\$10.00 per thousand.
4 inch.....	10,000.....	12.00 per thousand.
5 inch.....	7,000.....	18.00 per thousand.
6 inch.....	5,000.....	23.00 per thousand.
7 inch.....	3,500.....	32.00 per thousand.
8 inch.....	3,000.....	40.00 per thousand.
10 inch.....	2,500.....	60.00 per thousand.
12 inch.....	2,000.....	80.00 per thousand.
14 inch.....	1,200.....	110.00 per thousand.
15 inch.....	1,000.....	125.00 per thousand.

The deeper the clay the better the quality for tile-making at the Fowler plant. The upper portion contains less sand and shrinks more in drying than the lower. A mixture of clays from top to bottom of the pit is aimed to be used, and the more thorough the mixture the better the product. By going deeper it is more than probable that a finer-grained blue clay will be found which can be made into terra cotta lumber, hollow brick and other products.

Ordinary building brick in small numbers are also produced at Fowler. It is claimed, however, that, on account of being made on a tile machine, they are compressed too firmly, and are left with too smooth a surface. As a consequence, they crack too easily in drying. There is at Fowler, however, room and plenty of raw material for a good, ordinary brick factory.

At Oxford, John Lawson has been making drain tile on a small scale for 15 years. On his tile yard is a flowing well 50 feet deep, which pierces the gravel beneath the blue clay. The clay for tile is gotten from low ground. Eight inches of soil are stripped, and 16 inches of a blackish sedimentary clay wholly free from lime pebbles are first taken out. This is mixed with three feet of underlying yellowish clay, then passed through a crusher and made into tile on a Hoosier tile machine. The tile are air-dried in sheds and when burned are smooth, a bright-red in color and of excellent quality. About \$5,000 are invested in the enterprise and the annual output is valued at \$3,500.

At Otterbein tile have been made by Wm. Lawson since 1891, and a factory is also in operation on Pine Creek, in the eastern part of the county. I was unable to examine the clays at these factories, but it is said that they are "drift clays" of good quality for tile-making.

Other tile factories have been in operation at Templeton, Wadena and Boswell, but have been abandoned in recent years. The reason for this abandonment as well as that of the decreased output at all other factories are several; chief among which was the business depression of 1893-5, causing farmers to stop drainage on account of a lack of money; the gradually decreasing amount of lands needing drainage, and the selling in Benton County of tile from Summitville and other points in the natural gas field, cheaper than they could be there manufactured at a living profit.

On the whole, it may be said that the clay resources of Benton County are inferior in value to those of the counties in the coal-bearing area of Indiana, or of some of the counties adjacent to Lake Michigan. But what the county lacks in clays it far more than offsets in the richness and productiveness of its prairie soils.

THE CLAYS AND CLAY INDUSTRIES OF NEWTON COUNTY.

Newton County comprises 400 square miles of northwestern Indiana, lying adjacent to the Illinois line, north of Benton and west of Jasper counties. The Kankakee River forms its northern boundary and drains the northern half of its area. The Iroquois River flows across the southern half of the county from east to west. It forms the northern boundary of that magnificent prairie region which embraces the southern third of Newton and all of Benton counties. North of the Iroquois are also some fine prairies which extend to the southern border of McClellan and Colfax townships.

With the exception of about 25,000 acres, formerly comprising Beaver Lake, the surface of the four northern townships of Newton County is covered with loose sand. Up to the present this sandy area has been deemed comparatively worthless for agricultural purposes, but the time will soon come when, by proper cultivation, it will be made to yield handsome returns in small fruits and certain vegetables. The area covered by Beaver Lake was long since drained into the Kankakee and now comprises one of the most productive regions of the county.

The clays of Newton County are, all of them, drift clays or marly clays. They were deposited either by melting ice or by the still water of the numerous shallow lakes which for centuries immediately following the glacial period covered the greater portion of the county. In many places they cover the uppermost rocks to a depth of 120 to 140 feet, and in but a few known places are they less than 10 feet in thickness. The northern third of the county was not visited since it is so covered with sand and lacking in railway facilities for transporting clay products. The fine-grained blue clay common to the region will doubtless be found to underlie all of this sandy area to a great depth.

In the vicinity of Kentland there are no clay factories, and no openings where the strata of underlying clay are exposed. The record of the well in the public square shows the blue glacial clay to be 146 feet in thickness. At Kent's warehouse it was 80 feet, and on Kent's farm, two miles southwest of Kentland, section 29 (27 north, 9 west), 50 feet in thickness.

A brick yard was for some time located on the north side of the Iroquois River, where the road running north from Kentland crosses that stream, southwest quarter of section 34 (28 north, 9 west). The clay is yet exposed in a cut by the roadside to a depth of five feet. It

is a fine-grained, reddish, loamy clay, free from pebbles and lime, and will withstand much heat when burned. It should make excellent ordinary brick, but is not suited for drain tile on account of the large amount of free silica which it contains.

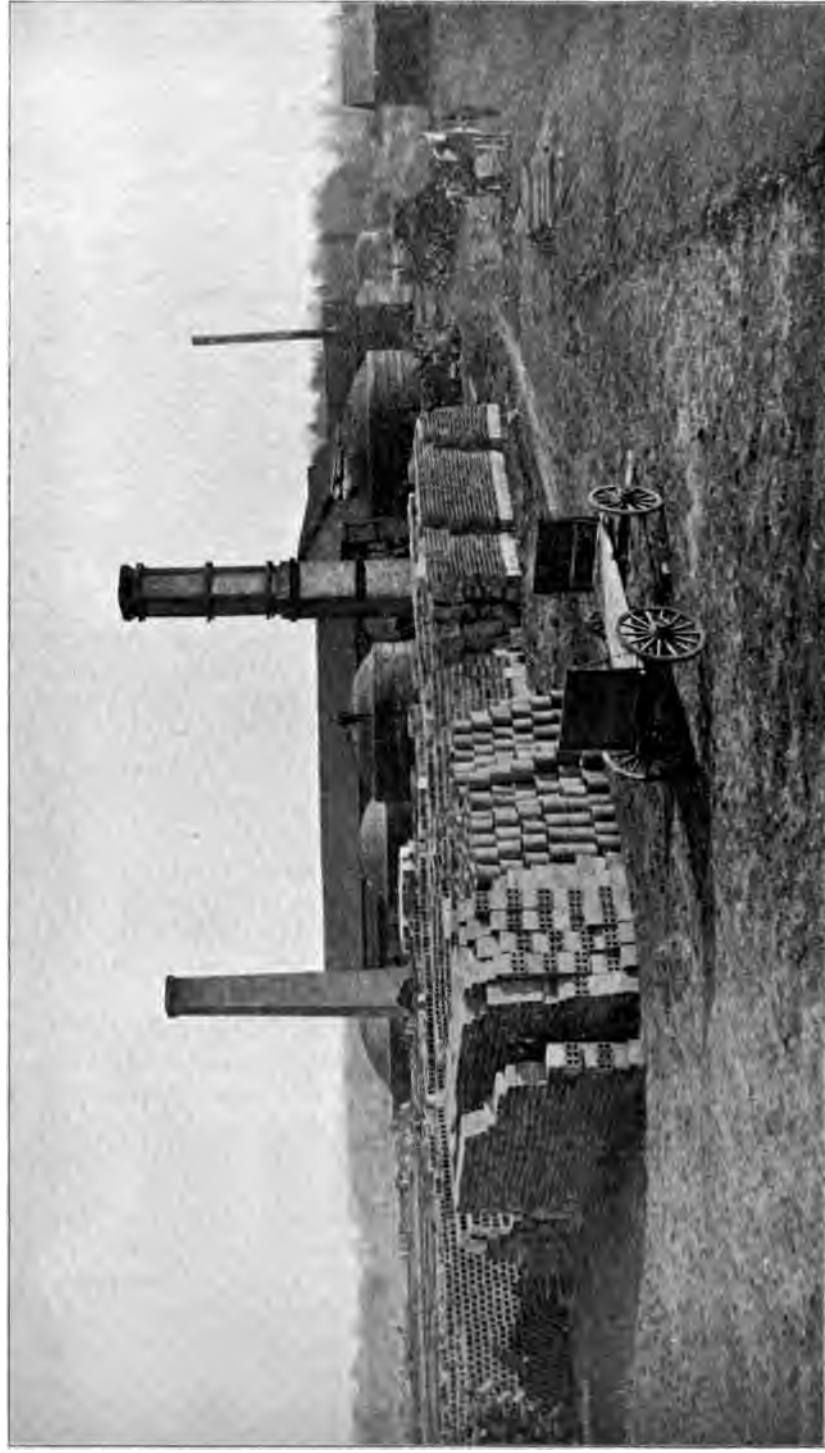
At Morocco, in the south half of section 21 (29 north, 9 west), Dar-roch Bros. have been operating a brick and tile yard for four years. The firm have their plant very well fitted with machinery, but are unfortunate in the selection of their clay. Seven inches of soil is stripped and three feet of brownish drift clay is utilized. It is very full of lime pebbles, and for that reason the tile and brick are of poor quality. One hundred yards north of their plant the blue clay comes within five feet of the surface and will make much better tile, but they will be yellowish-white in color. Two well sections at Morocco show this blue clay to be 113 and 120 feet in thickness, very fine-grained and very plastic.

A much better clay for tile and brick-making occurs at Beaver City, and has been worked by M. E. Handley since 1893. The section at the pit is as follows:

1. Soil—stripped ½ foot.
2. Yellowish sandy clay 3½ feet.
3. Tough, bluish clay 4½ feet.

Wares made from the above yellowish clay air crack in drying, especially if exposed to the wind. When the yellow clay is mixed with the blue this is prevented. The blue clay has been proven by a bore to be 140 feet in thickness. But little trouble is had with lime pebbles, as comparatively few are present. The clay is thoroughly moistened, pugged and crushed before entering the machine. The mixture burns red, and the owner claims that red tile sell much better than white, as they stand freezing better. Tile from 3½ to 12 inches in size are made and more were sold in 1897 than any year since the factory was started. The brick made are of fair quality and bring \$8.00 per thousand at the yard, but the local demand is small.

At Mt. Ayr, on the La Crosse Branch of the C. & E. I. Railway, a grayish-blue clay comes close to the surface in a marshy field in the eastern outskirts of the town, and is worked into brick and clay by Stucker & Covert. It is fine-grained and tough, but contains occasional botryoidal masses of pure amorphous carbonate of lime the size of a marble or smaller. No true pebbles of lime are found in the clay and a similar occurrence of amorphous lime was noted nowhere else in northwestern Indiana. The clay itself possesses scarcely enough lime in its composition to cause an effervescence with acids, and burns a bright red. Four to six feet of it are used, the deeper portions burn-



YARD AND WORKS OF THE J. H. HAYNES CO., BROOK, NEWTON COUNTY, IND.

ing to wares of a lighter color. About 25 kilns of a good quality of tile are made at this factory besides enough brick to supply the local demand. If the lime above mentioned was absent, the clay would be of most excellent quality for drain tile, flue linings and fire-proofing.

The J. H. Haynes Company, of Brook, have the largest and best-equipped clay factory in Newton County. Their clays are also excellently suited for the wares which they are making. A section at their pit, northwest quarter of section 20 (28 north, 8 west), showed as follows:

1. Black soil1 foot.
2. Yellowish loamy clay.....2 feet.
3. Grayish or drab, marly clay.....3 to 6 feet.
4. Tough blue marly clay.....2 to 5 feet.
5. Gravel and sand.....? ?

The entire deposit was evidently laid down in still water instead of being dropped by melting ice. As a consequence but little trouble is experienced with lime pebbles. From a portion of the soil and the loamy clay—No. 2—ordinary red brick and drain tile were made for a number of years. In 1895 the company begun to utilize the upper marly clay—No. 3—in making terra cotta lumber for the Chicago market. This clay is a silt, the lower part of the stratum being in thin layers with a coating of sand between them. An incomplete analysis shows that it contains about 10 per cent. of magnesium and lime carbonates. In the making of terra cotta lumber three parts of clay are mixed with one part of sawdust. The mixture is passed through a pugmill and crushed, and then through an Adrian tile machine fitted with dies of the proper pattern for the product desired. The so-called lumber is in reality a hollow brick, 12x12 inches square and 3, 4 or 6 inches thick. The walls are three-fourths of an inch thick and the hollow portion has two partitions to give the structure additional strength. At the present time the brick are dried in sheds for six to eight days, but a tunnel dryer will soon be constructed. After drying they are burned for 36 hours, and, the sawdust being consumed, leaves the product very light and porous, but at the same time strong enough for all purposes for which it is used.

On account of the porosity, this "clay lumber" can be readily sawed to any desired shape, and a nail can be driven into it with as much ease as into a pine board. It is used mainly for partition walls in fire-proof buildings, and is rapidly taking the place of ordinary brick and solid fire-proofing for that purpose. Its advantages over the latter are obvious. On account of a grooved outer surface, plaster is spread over

it without the use of intervening laths. Any wood finish can be nailed directly to it; while with a saw or trowel it can be quickly cut into any desired shape. Its weight is as follows:

3 inch.....	13,500 lbs. per 1,000 square feet.
4 inch.....	15,000 lbs. per 1,000 square feet.
6 inch.....	20,000 lbs. per 1,000 square feet.

The prices at which it was sold in 1896 were \$27.50, \$30.00 and \$35.00, respectively for the sizes made, delivered in Chicago.

From the blue clay, No. 4 of the section, flue linings, solid fire-proofing, furring brick and foundation brick are made. This clay, as well as No. 3, burn to a cream color on account of the large percentage of lime which they contain. With a better system of drying their wares, and with a few additional kilns, this company will have their plant in excellent condition to meet almost any demand. Their trade is constantly increasing, as they aim to make all their products of the best possible quality and sell them at reasonable prices.

The Goodland Tile Company has been making brick and tile at Goodland, in the southeast corner of Newton County, for 12 years. The clay which is mostly used is peculiar for this region of the State, in that it is a pinkish-red in color. It resembles closely the clay of the same color found near Freedom, Owen County,* which is quite largely used in the making of encaustic tile and terra cotta. Both are very fine-grained, free from grit and pebbles, and exceedingly tough and plastic. The clay at Goodland effervesces rather freely with muriatic acid, showing that it contains several per cent. of lime carbonate, while on that from Owen County acid has no effect. The latter is, therefore, much the more refractory.

The section at the clay pit at Goodland was as follows:

1. Soil1 foot.
- *2. Grayish pebbly hard pan or drift clay.....2 to 3½ feet.
3. Pink clay4 to 10 feet.
4. Blue clay merging into shale.....5 to 8 feet.

The pink clay covers a large area southeast of Goodland, southwest quarter of section 25 (27 north, 8 west), on the land of W. J. Stewart. Burned by itself, it produces ware of a dark-red color. Mixed with the overlying grayish clay, it burns brown. Drain tile made from it are very hard and ring when struck, as though composed of iron. On account of its tough, plastic condition it is apt to twist and shrink under the influence of great heat. It must be thoroughly moistened

* See 20th Ann. Rep. Ind. Dep. Geol., 1895, 85.

in a pug mill, as it is too tough to work dry. When properly tempered or weathered it does not air-crack in drying. It possesses all the properties of an excellent modeling clay, and is of too high a grade to be used only for brick and drain tile, as it is at present.

The Goodland Company have a very well equipped plant, but in the past have made many poor tile from the upper pebbly clay, and have thousands of them on their yard. Besides drain tile and ordinary brick, they make solid fire-proofing, hollow brick and foundation brick. Of ordinary brick their output is only about 100,000 per year, which they sell for \$8.00 per thousand at the yard. In 1896 they made 55 kilns of drain tile, but in 1897 the long strike among the coal miners shortened their season and they produced less than half as many.

From what has been stated it will be seen that the clays of Newton County are more varied in character and of better average grade than those of Benton. Good deposits of marly clay, suitable for terra cotta lumber, doubtless occur along the Iroquois River, east and west of Brook. Three railways pass through the county and its proximity to the coal fields of both Indiana and Illinois renders cheap fuel a certainty. There is no reason why larger clay industries should not start up and flourish, especially at Goodland and Brook.

THE CLAYS AND CLAY INDUSTRIES OF JASPER COUNTY.

Jasper County lies east of Newton and south of the Kankakee River, which forms its northern boundary. The Iroquois River, with its tributaries, Pickamink River and Carpenter's Creek, drains about three-fourths of its area. The county contains 550 square miles of surface, which is very diversified in character. The northern half is, for the most part, sandy, with intervening low prairies, marshes, and ridges and knolls covered with scrub oak timber.

The marshes and wet prairies, when drained, produce excellent crops, and comprise the best land in this section of the county. In Barkley, Gillam and Walker townships is one tract of 33,000 acres, owned by Benjamin J. Gifford, of Kankakee, Illinois, a large portion of which has been drained since 1893. On it are now more than one hundred dwellings, with good outbuildings and young orchards. Immense crops of oats and corn are produced and a thriving farming community now exists where, but a few years ago, only the wild duck and the muskrat flourished. The southwestern part of the county is a gently rolling prairie of black loamy soil.

The clays of Jasper County are the characteristic drift and marly clays of northwestern Indiana. The best grade of clay noted is located

one and one-half miles north of Rensselaer, in section 7 (29 north, 6 west), and is utilized for drain tile by A. E. & H. A. Alter. A prominent ridge rises 30 or more feet above the plain on which Rensselaer stands, passes east and west through this and adjoining sections and contains the deposit of clay. At the pit near the summit of this ridge, the section exposed was as follows:

1. Soil 8 inches.
2. Yellow clay with occasional pebbles..... 3½ feet.
3. Grayish blue clay.....10 feet.

A well close to the pit pierced the blue clay to a depth of 126 feet before striking a water supply in gravel. In the making of tile but a few inches containing the roots of grass are stripped, and the clay from top to bottom of the pit is mixed, in the proportion in which it occurs. This mixture is soaked for a day or two and then passed through a Potts disintegrator and made into tile on a New Departure machine. The mixture burns pinkish on account of the presence of the top stratum. By itself the lower stratum burns to a cream color.

The grayish blue clay is very hard and has to be dug with a pick, as a spade will not penetrate it. It is fine-grained and very stiff and tenacious. It makes a firm, smooth tile of excellent quality, for which the demand has lately been greater than the supply. With proper weathering and tempering it could be made into hollow brick, flue linings, fire-proofing and many similar products, but contains too high a percentage of fluxes for paving brick, sewer pipe or other vitrified wares. The deposit of this clay comes close to the surface over several sections, both east and west of the point where it is worked and its quality is such as to merit a more extended use.

On the land of John T. Randall, near the postoffice of Pleasant Grove, 10 miles northeast of Rensselaer, drain tile has been made for 11 years. The material used is the ordinary fine-grained blue clay, mixed with about one foot of black soil and two feet of red clay. The blue clay at this point is 50 feet in thickness. Wares made of it alone air-crack in drying. Many unburned tile which had been exposed to a strong wind and had cracked were scattered about the yard. Some trouble is also experienced with lime pebbles in the red clay. About 50 kilns are burned each year. The tile are not nested when set in the kiln, and for that reason the average value of the kiln is but about \$90.00. Wood is used for fuel at a cost of about \$2.00 per cord. The owner claimed that below the depth exposed the blue clay became of the same character as that north of Rensselaer.

Good clay for drain tile, fire-proofing, etc., also occurs on the land of John English, northeast quarter of section 9 (29 north, 6 west), and on that of Murray Bros., northeast quarter of section 10 (29 north, 6 west).

Just west of Rensselaer, on the north half of section 25 (29 north, 7 west), John Kohler & Son have been making brick and tile for 11 years. The section exposed at their clay pit is as follows:

- | | | |
|---------------------------------------|---------|-------|
| 1. Soil and surface clay..... | 1½ | feet. |
| 2. Tough. plastic bluish clay..... | 4 | feet. |
| 3. Bluish pebbly clay..... | 1½ | feet. |
| 4. Bluish clay free from pebbles..... | 8 to 10 | feet. |

Stratum No. 1 is used for making brick and No. 2 for tile. Several kilns of brick were at one time made from the pebbly clay. No. 3. The lime in these caused them to crumble badly and gave the brick from this yard a poor reputation, causing the local trade to go elsewhere for its supply. More care is now taken to avoid the use of this stratum, and the brick on the yard were of good quality, but were bringing but \$4.75 per thousand, delivered in Rensselaer.

Were it not for the heavy stripping the lower stratum, No. 4, would be used for brick. It has been tested and forms a very hard, whitish product. Clays of the same quality as those of this yard occur close to the surface over an area of one and one-fourth miles long and one-half mile wide west of Rensselaer.

On the land of Dr. W. W. Hartsell, two miles west and one mile south of Rensselaer, a well section showed 4 feet of soil and loam and 30 feet of clay; the latter being very sticky, fine-grained and free from grit or pebble. Just as it comes from the bed it can be formed by the hands into shallow vessels which will hold water until it evaporates. It can be burned into solid fire-proofing, flue linings, foundation brick, etc.; but will probably need some tempering with sand on account of its great tenaciousness.

A similar clay to that on the Hartsell farm is exposed in a large dredged ditch in Milroy Township. This ditch is a mile in length, extending from the center of section 10 to the center of section 15 (28 north, 6 west). The upper portion of the clay lies from two to four feet below the surface, but its thickness has never been ascertained. When damp it can be cut into ribbon as thin as a knife blade and a yard long. When dry it is very hard and tough. It is probably too far distant from a railway for utilization.

At Remington, on the P., C. & St. L. Railway, near the southern edge of the county, a tough blue clay is made into tile by Samuel Bowman. It lies immediately below eight inches of soil, part of which is

mixed with it when used. It contains numerous pebbles which must be crushed, or thrown out by a disintegrator, but otherwise is well suited for tile-making. Enough ordinary brick are made to supply the local demand.

This comprises all the exposures of clay which I was enabled to visit in Jasper County. The blue clay which is the more common probably underlies the entire county, but only in the vicinity of Rensselaer was it found of a quality suitable for making other wares than drain tile.

THE CLAYS OF STARKE COUNTY.

Starke County lies east of Jasper, in the second tier of counties south of Michigan, and in the third east of Illinois. Its eastern border is 18 miles and its southern border 24 miles in length. Nine miles west of its northeastern corner the Kankakee River intervenes between it and Laporte County, and, flowing southwesterly, forms the remainder of the northern and all but five miles of the western boundary. Yellow River, flowing west through the center of the county, and Bogus River and Pine Creek, north through the southwestern fourth, empty into the Kankakee. Bass Lake, formerly known as Cedar Lake, lies in the southeastern part and is $3 \times 1\frac{1}{2}$ miles in area, with an average depth of about 20 feet.

The county has an area of 306 square miles, the surface of which is diversified by marsh, wet prairie, dry prairie and sand ridge, the latter predominating. More than half of the area is covered to a depth of 2 to 15 feet by the fine-grained buff sand so characteristic of all the region adjacent to the Kankakee on the south. Experience has proven that this sandy soil, if properly cultivated, will produce excellent melons, sugar beets, berries, grapes, etc. Where ploughed deep and fertilized it also yields good crops of corn, oats and potatoes. Within the past ten years colonies of frugal, industrious Germans and Swedes have bought at a low price large areas of this once despised land and are making a good living from it. They utilize all fertilizers produced on the farm; they haul muck from the lowlands and mix it with the sand; they plough deeply each season; and by these means and others are proving the land of far greater productive power than it was ever believed to be.

Many thousand acres of the marsh land in the northern half of the county have been recently drained, and where a few years ago the waters were waist-deep the year round bountiful crops of corn are now produced. That the county is rapidly coming to the front agricultu-

rally is proven by the growth of Knox, the county seat, where several fine business blocks were erected in 1897, and where a \$90,000 court house will be finished next year.

Beneath the sand, the prairie sod and the marsh bottoms of Starke County there is everywhere the fine-grained, ash-blue bowlder clay which covers the entire area of northwestern Indiana. In many places this comes close to the surface, yet there is not at the present time a brick yard, tile factory or clay industry of any kind within the bounds of the county. Several brick factories have been started in the past, but always by some one inexperienced in clay-working and usually without capital. As a result, they were failures, and, after a few kilns were burned, they were abandoned.

One of these factories was located in section 5 (32 north, 2 west), one and three-fourths miles east of Toto, a station on the "Three I" Railway. A record of the well on the former yard is as follows:

- | | |
|----------------------|-----------|
| 1. Sand | 2 feet. |
| 2. Yellow clay | 4 feet. |
| 3. Blue clay | .38 feet. |
| 4. Sand | 8 feet. |
| 5. Blue clay | .23 feet. |
| 6. Sand | 5 feet. |

A plentiful supply of water was obtained in the third stratum of sand.

The clay used was that from stratum No. 2, mixed with a foot or two of that from No. 3. It contains quite a percentage of disseminated carbonate of lime, but no lime pebbles. The mixture burns red, and, from samples of brick and tile left on the yard, produced wares of good quality. Wood, costing but \$1.25 per cord, was used for fuel, and the brick were sold at the yard for \$6.00 per thousand. They were made on a Penfield brick and tile machine, which is still in the abandoned shed, and dried in an open yard. The parties claimed that the location was too distant from Knox, about five miles to the northeast, where the brick were mostly sold, and that the demand was too limited to continue the business.

On the land of Isaac R. Bascom, northeast quarter of section 1 (32 north, 3 west), one-third of a mile west of Toto, a reddish yellow clay comes to the surface near the right of way of the "Three I" railway. This clay has been proven by tests in three factories to be well fitted for the making of brick and tile. It contains some pebbles, and a disintegrator and crusher would have to be used. This location is probably the best in the county for a clay factory for brick and tile, as a switch could be put into the plant with but little expense. Water

in abundance can be obtained at all seasons from the Bass Lake outlet, which passes through the deposit. A factory started at this place could supply at a low rate all the brick needed in the towns of Starke County along the "Three I" railway, and at the same time the constantly increasing local demand for tile among the farmers. At present these clay products are shipped into both Knox and North Judson from other counties.

Three miles south of Knox, on the land of John Lindstrand, northwest quarter of section 3 (32 north, 2 west), is also a deposit of clay suitable for brick and tile. It covers 40 or more acres and comes to within less than a foot of the surface.

On the line between Marshall and Starke counties, section 36 (33 north, 1 west), a brick and tile factory was in operation for a number of years, but has been recently abandoned on account of its distance from a town of any size. I did not visit this point, but was informed that the wares made gave good satisfaction wherever used.

Nine miles west of Knox, on the land of Fred. Surma, northeast quarter of section 33 (33 north, 3 west), a number of kilns of brick have been burned to supply a local demand, but no permanent factory has been started. Just across Yellow River, one-third of a mile north of the Court House at Knox, several kilns were also made a number of years ago, but the clay is of poor quality and in no place more than two feet in thickness, and overlies a bed of sand. It was used only because no better deposit was thought to occur in the county.

These constitute all the points, as far as could be ascertained, at which clay suitable for brick or tile comes close to the surface in Starke County. By stripping the sand the blue clay will be everywhere found, but ordinary brick have not as yet been made from it. Custom has established the idea that brick and tile should be of a red color, and since the blue clay burns yellow, it is wrongly considered to be useless for such wares. At any one of two or three of the points mentioned a man with a practical knowledge of clay working and possessed of energy could establish a combined brick and tile factory on a paying basis, since a county which is advancing as rapidly as Starke should by all means support at least one such factory within her bounds.

THE CLAYS AND CLAY INDUSTRIES OF LAKE COUNTY.

The location and leading surface features of Lake and Porter counties are given in another paper in the present volume, hence they are not treated in this connection. The clays of the county which come close enough to the surface for utilization are of two kinds,

drift clays and silty or marly clays. The drift clays are utilized at Lowell and Crown Point in the making of brick and drain tile, and the silty clays, at Hobart, on an extensive scale, in the making of terra cotta lumber, flue lining, fire-proofing and ordinary and pressed front brick.

At Lowell the clay factory has been operated by P. D. Clark for 13 years. The amount invested is but \$5,000 and the value of the annual output is about the same, equally divided between the two products. The clay used is gotten from a hillside northwest of the town, northwest quarter of section 23 (33 north, 9 west). It is a tough yellowish drift clay about 12 feet in thickness, with many small pebbles of lime carbonate and other material scattered through the basal portion. For this reason only the upper four or five feet are used and this has to be passed through a crusher. Underlying the clay stratum is a thick deposit of coarse sand.

The plant is located at the base of the hill, and the clay is hauled to it in carts. After being crushed it is passed through a perpendicular pug mill and then through a "Little Wonder" brick and tile machine. The products are dried by air in sheds and burned in round down-draft kilns. Aside from an occasional pebble, which escapes the crusher, and causes a flaking of the surface, the brick and tile are of good quality. The clay, however, is not suited for higher grade products.

Drift clay similar to that used at Lowell lies near the surface over an area about three miles wide between Lowell and Crown Point. At the latter place H. W. Wise has been making brick from it for 24 years and has lately begun the making of tile. Only about three feet of the clay can be used on account of the pebbles in the lower portion of the bed. A Penfield brick and tile machine is used and the value of the annual output is about \$2,500.

By the side of the Pittsburg, Fort Wayne & Chicago Railway, just north of Hobart, in the southwest quarter of section 29, and the southeast quarter of section 30, (36 north, 7 west), is one of the largest, best known and most valuable deposits of silty clay in northwestern Indiana. For a long period ordinary soft mud brick were made in large numbers from the surface portion of this deposit, but in April, 1887, W. B. Owen began the making of terra cotta lumber and fire-proof products from the deeper portions of the clay bed, and this business, now carried on under the name of "The Hobart Terra Cotta Lumber Company," has become one of the most important clay industries in the State. The pit at the Owen yard covers an area of about four acres and is 25 feet deep. A section of it showed as follows:

1. Soil 6 inches.
2. Fine grained yellowish marly clay..... $2\frac{1}{2}$ to 3 feet.
3. Grayish-blue clay, exceedingly fine grained. 21 feet.

The two clays, Nos. 2 and 3, were, when deposited, doubtless of the same color, and the difference in hue now existing has been caused by leaching waters. No. 3 has been pierced by a bore to a depth of 132 feet without reaching its base. The deposit is a well-defined silt, the upper six to ten feet of blue clay being in layers two to six inches thick, with each layer separated from the one above and below by a thin coating of sand. Towards the bottom of the exposure the layers become thicker, eight to fourteen inches, and the clay is more condensed and contains less free silica. Not a pebble or solid body of any size occurs in the entire deposit, and it was most probably laid down by slow deposition in the waters of a shallow bay which formed an adjunct to the highest stage of the old glacial Lake Chicago.*

When dry the clay becomes much lighter in color. By itself it burns to a dark cream, and, when mixed with the surface stratum, to a light pinkish hue. On account of the presence of about 20 per cent. of calcium and magnesium carbonates, the clay effervesces freely with acids. Its chemical composition, as determined by Noyes, is as follows:

ANALYSIS OF MARLY CLAY FROM HOBART, IND.

	Per Cent.
Silica	50.56
Titanium oxide	1.00
Alumina	13.11
Combined water	2.76
Clay base and sand.....	67.43
Ferric oxide	2.98
Ferrous oxide	2.32
Lime	7.87
Magnesia	5.06
Potash	3.74
Soda .....	.70
Fluxes	22.67
Carbon dioxide	9.62
	9.62
Total	99.72

The large percentage of the fluxes present shows that wares from this clay can not be subjected to great heat on account of the danger

*See p. 33 of the present volume.



CLAY PIT OF HOBART TERRA COTTA LUMBER COMPANY, HOBART, INDIANA.

20

of their melting down. The clay is peculiarly fitted for a light, porous product, which does not require the properties of hardness or toughness.

In the making of the terra cotta lumber and other fire-proof products, the clay is excavated with spades and elevated in tram-cars as fast as needed to the upper floor of the plant, where it is dumped by the side of an opening leading to a perpendicular pug mill. From the opposite side of the building a belt carrier elevates screened sawdust and drops it near the same point. The clay is moistened by sprinkling water over it with a hose, and two men scoop alternate shovelfuls of clay and sawdust into the pug mill. In it the two are thoroughly mixed and then passed into a horizontal brick machine, from which the mixture emerges as a cylindrical roll eight inches in diameter. This is cut into blocks 14 inches long, which are elevated to the top of a Vaughn & Taylor sewer-pipe press fitted with dies of the proper size and pattern for the product desired. As fast as taken from the press the wares are placed on double-deck iron cars, 280 of which are in use, and dried by steam in tunnel dryers. The kilns in which it is burned are ten in number, rectangular down-draft, each one holding 10,000 feet of six-inch partition. The output of the plant averages 60 tons a day of the finished product, and the drying and burning capacity is sufficient to take care of this amount. About nine days are required from the time the clay is taken from the pit until the finished material is ready to load on the cars. Sixty carloads a month are shipped to all parts of the United States; the value of the annual output being from \$60,000 to \$75,000. The products of this plant consist of wall partition or fire-proofing, from seven-eighths to twelve inches in thickness; floor arching, wall furring, column and girder covering, under-roofing to which slate or roofing tile can be nailed, and everything in the clay line that goes inside the walls of a fire-proof building. For the porous wall partition the following points of advantage are claimed:

1. It is a non-conductor of heat, cold and sound.
2. One coat of plaster, without studding or lath, finishes the partition.
3. It can be shaped with edge tools and holds nails and screws.
4. It can be put in place more rapidly and at less cost than brick.
5. Its cost to the consumer is only slightly greater than wood.

But three factories are at present making this porous partition in the States of Illinois and Indiana; one located at Pullman, Illinois,

one (described in the present paper) at Brook, Indiana, and the one at Hobart. The demand is constantly increasing and the factory at Hobart made no stop during the panic of 1893-'95.

Just across the railway from the Owen factory is the Kulage Brick and Tile Works, where, for a number of years, large quantities of ordinary brick and drain tile have been made. In 1897 the owners began the erection of a large plant for the making of dry pressed brick.

From numerous experiments which have been made it has been found that by proper mixture high-grade dry-pressed brick of a number of different shades between a deep red and a handsome cream color can be made from the clays of the vicinity. A mixture of equal parts of the upper and the lower clays burns to a beautiful shade of pink.

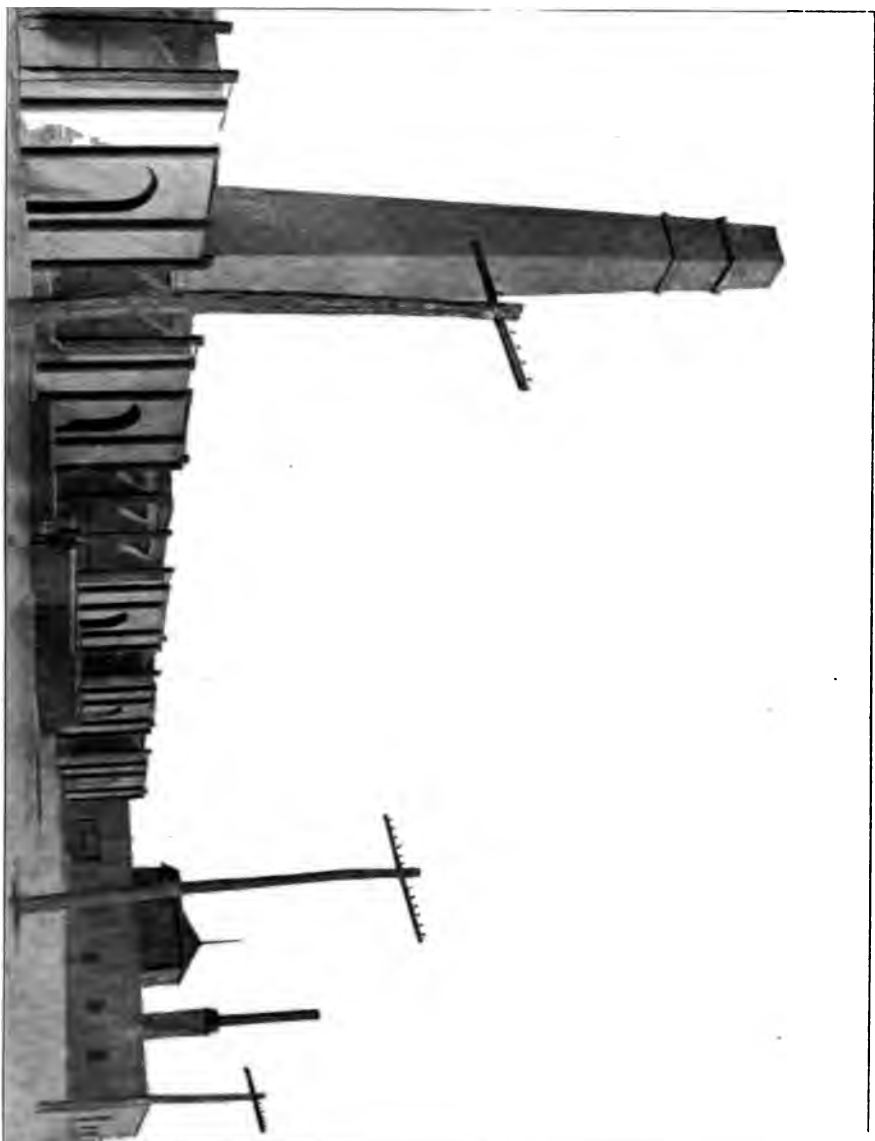
Five large, rectangular down-draft kilns, each 100 feet long by 20 wide, and holding 260,000 brick, were erected in 1897. These kilns were constructed of ordinary brick burned from the clays at hand, and were lined with Ottawa fire block. They were built according to the designs and inventions of the Kulage Company, and are probably the largest kilns of the down-draft type in existence, their combined capacity being nearly as great as that of a dozen down-draft kilns of the usual size. Each kiln is so constructed as to be operated separately and independently, or the entire set may be connected and used as a continuous system, thereby reducing materially the cost of burning. These kilns also admit the setting and burning of shaped, ornamental, glazed and enameled brick with the plain brick without interfering with the latter.

When in operation the clays will be ground in a nine-foot dry pan, passed over rotary screens and made into brick on presses designed and manufactured by the Kulage Company, of St. Louis, who are erecting the plant. Their presses are the "Challenge," of 25,000, and the "Triumph," of 35,000 daily capacity. The latter is a quadruple pressure machine, weighing 40,000 pounds, and it is claimed, gives a pressure three times as great as any secured on the ordinary pressed brick machine in use.

The section exposed in the Kulage Company's pit in July, 1897, was as follows:

Soil	4 to 6 inches.
Yellow marly clay.....	6 to 7.5 feet.
Bluish-gray marly clay.....	4 to 7 feet.

The blue clay has been proven by bores put down in a number of places on the land of the Kulage Company to be more than 90 feet in



KULAAGE BRICK AND TILE WORKS, HOBART, IND.
(Kilns in course of construction.)

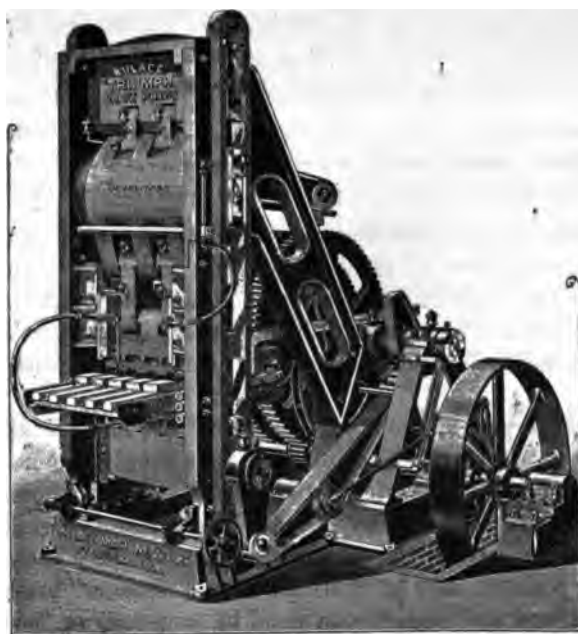


FIG. 10. TRIUMPH BRICK PRESS. (Front View.)

thickness. Its properties are essentially the same as those of the clay at the Owen pit above mentioned. It is found over a large area in sections 19, 20, 29 and 30 (36 north, 7 west), north of Hobart, and also south and east of that town, but in most places the stripping is so heavy as to prevent its utilization. In a well near the center of Hobart it was found to be overlain by 22 feet of sand. In the yard of J. A. Johnson, in the northwest quarter of section 20, seven feet of sand and six feet of yellow clay lie above it. Along Deep River it outcrops in a number of places, but usually in localities where it can not be utilized on account of the Spring overflows. Its constituents and properties are the same wherever found within the limits once occupied by the bay of Lake Chicago. This is shown by the chemical analyses, printed on succeeding pages of this paper, of samples taken at Garden City, Chesterton and near Michigan City.

THE CLAYS AND CLAY INDUSTRIES OF PORTER COUNTY.

The clays of Porter County, like those of Lake, are sedimentary in nature and belong to the two groups of "drift clays" and "marly clays." The drift clays are made into ordinary brick and drain tile at Hebron and Valparaiso, and the marly clays into pressed front brick at Porter, and ordinary brick at Garden City and Chesterton.

One-third of a mile west of Hebron the "Panhandle" Railway has exposed the drift clays to a depth of 14 feet. At this cut, in September, 1897, the following strata were disclosed:

1. Soil	16	inches.
2. Bluish "joint clay".....	3	feet.
3. Hard yellow clay.....	7 to 10	feet.

The bluish clay immediately below the soil was broken into irregular four-sided masses two or three inches long and an inch thick. The yellow clay was a solid homogeneous body, with here and there a lime pebble or small boulder embedded in its mass. Both clays effervesced freely with acids, showing the presence of a large percentage of lime carbonate.

In the south part of the town, H. Folsom has made brick from the upper clay for 28 years. The annual output is only enough to supply the local demand and varies between 100 and 500 thousand. Six inches of the surface are stripped and the remainder of it and two feet of the underlying clay are used; all below that containing too many lime pebbles. The brick are made on a "Quaker" machine, dried in an open yard and burned with wood in temporary or "scove" kilns. They sold, in 1897, at \$5.50 per thousand at the yard.

One-half mile north of Hebron, Kenny Bros. have been making drain tile from a clay found in marshy ground near their plant. Six inches of the soil are removed and three feet of the tough, bluish, very plastic clay utilized. Sand and gravel set in at about three feet and prevent the use of the lower portion of the clay bed. After passing the clay through a crusher the tile are made on an "A. C. Hockett" machine, and are of excellent quality. The value of the annual output is but about \$1,750.

In the south part of Valparaiso, Lambke Bros. are using the drift clay for making ordinary soft-mud brick and also a harder "sidewalk" brick for pavements and foundations. The clay used is obtained on a hillside and is quite free from pebbles to a depth of five feet, but below that distance they become more plentiful, and prevent its utilization. The clay is first passed through a disintegrator, then through a Williams pulverizer and over an oscillatory-inclined screen. It is then passed through a pug mill and a "Creager" machine, and the resulting brick are dried on pallets in open sheds. Two round down-draft kilns, each holding 43,000 brick, are used in burning the sidewalk brick, 600,000 of which were made in 1897, and sold at \$6.75 per thousand. The building brick are burned in "scove" kilns of 280,000 capacity. Crude petroleum is used as fuel and costs at the plant \$1.60 per hundred gallons. On account of the thorough preparation

which the clay receives, the brick made are of excellent quality and find a ready market in Valparaiso at \$5.50 per thousand, delivered. The annual output is about one million.

In the north part of Valparaiso, Coover & Clevenger are making drain tile from clay which they obtain from a swamp, one-half mile northeast from their plant. It is the characteristic tough blue clay which underlies the mucky soil of the swamps of this region. Three and one-half feet are used after stripping four inches. The clay is passed through two crushers, and then through an "Ohio" auger machine. The resulting tile are air-dried in sheds and burned 48 hours with crude oil. It is claimed that this fuel burns the product more quickly, requires less labor and produces better ware than any other. The value of the annual output at this plant is about \$3,000; the price for four-inch tile in 1897 being \$14.00, and for ten-inch, \$75.00 per thousand, at the yard.

At Garden City, two miles southeast of Hobart, on the line between Lake and Porter counties, a fine bed of marly clay occurs which was deposited at the same time and by the same agencies as the bed at Hobart. The P., F. W. & C. and the "Nickle Plate" railways, which here run side by side, are just south of this deposit, and a switch from the latter enters the yard of the factory which has been erected. At this factory ordinary stiff-mud brick have, in the past, been made in large quantities for the Chicago market. The plant has been well equipped for making these brick in large numbers, but, unfortunately, has been owned and managed by parties who were not practical brick men, and who, therefore, could not successfully carry on the business. As a result, it has been idle for a large part of the time during the past three years. At the pit the following section was exposed in August, 1897:

1. Soil 8 inches.
2. Reddish marly clay..... 4 feet.
3. Buff sand 2 feet.
4. Bluish-gray marly clay..... 6 feet.
5. Bluish sand 2 feet.
6. Bluish-gray clay, fine grained.....20 feet.

A well on the yard has been sunk to a depth of 150 feet through the bluish clay, No. 6, to gravel, and an inexhaustible supply of good water obtained. With the exception of the sand strata, Nos. 3 and 5, this deposit is very similar to the one at Hobart. The blue clay is the same fine-grained, silty material, with a very similar chemical composition, as the following analysis, made by Noyes, will show:

ANALYSIS OF BLUISH GRAY CLAY AT GARDEN CITY, INDIANA.

	<i>Per Cent.</i>
Silica	50.37
Titanium oxide .....	.85
Alumina	9.93
Combined water	1.50
Clay-base and sand	62.45
Ferric oxide	2.10
Ferrous oxide	2.05
Lime	10.26
Magnesia	6.26
Potash	3.04
Soda .....	.79
Fluxes	24.50
Carbon dioxide	12.50
	<hr/> 12.50
Total	<hr/> 90.45

The samples analyzed were taken from near the surface of the bluish clay. If they had been gotten from a greater depth, as was the one from Hobart, the percentage of alumina would doubtless have been larger, and that of some of the fluxes less. The clay will be found to be well suited for the making of the same products as are made by the Owen Company at Hobart. Experiments will also doubtless show its fitness for structural terra cotta of good quality, since its constituents are very similar to those of one of the clays used by the largest factory manufacturing that product in New York, the Glens Falls Terra Cotta Company. An analysis of their clay is added for comparison:

ANALYSIS OF TERRA COTTA CLAY AT GLENS FALLS, N. Y.

Silica	48.35 per cent.
Alumina	11.33 per cent.
Oxides of iron	4.02 per cent.
Lime	15.38 per cent.
Magnesia	3.17 per cent.
Organic matter	1.18 per cent.
Potash and soda	6.05 per cent.
Carbon dioxide	10.52 per cent.

The high amount of lime and magnesia in the bluish-gray clays at Hobart and Garden City causes them to produce a light-colored ware. A mixture of this clay with the red clay above produces a speckled,

pinkish product, and the red clay alone a deep red product. A variety of different colored terra cotta can thus be made without the use of artificial coloring matter.

A new company has recently secured possession of the clay deposit and factory at Garden City and will make porous fire-proof products instead of brick. With a man who has a practical knowledge of the making of such wares in full control of the factory, there is little doubt of their ultimate success.

The same silty clays come near the surface in a number of places in the area formerly covered by the bay of the old glacial Lake Chicago, especially in sections 15, 22, 27 and 34 (36 north, 7 west), Portage Township, Porter County. They are at present at too great a distance from transportation facilities, but the time will come when their value for terra cotta and similar products will be better known, and to some of them railway switches will then be extended.

Near the junction of the Michigan Central and Lake Shore railways, at Porter, Indiana, is located the largest pressed front brick factory in the State. It is one of the several factories in different parts of the Union owned and operated by the Chicago Hydraulic Press Brick Company, and has been in operation since July, 1890. The clay used is a peculiar, fine-grained, buff material, entirely free from lime pebbles, and containing but a small percentage of lime carbonate as a constituent. It covers to a depth of six feet an area of 45 acres, owned by the company, in the northeast quarter of section 34 (37 north, 6 west), and is also the surface clay over quite an area in sections 27, 35 and 36, in the same township and range. Below it is usually found a bed of sand 25 or more feet in thickness.

In September, 1897, the clay was being gathered at the yard just north of the company's plant, and stored in sheds for winter use. A special harrow-shaped plow, designed and made at Findlay, Ohio, and propelled by a 12-horse-power traction engine, loosens the clay over an area six feet wide, to a depth of three inches. This plowing is done on a gradual slope, so as to get a uniform mixture of the clay and prevent uneven shrinkage in the brick. Ten rotary excavators, each holding enough clay for 300 bricks, follow the plow and gather up the clay. They convey it to the storage sheds, three in number, which, when full, hold enough to make seven millions of brick. From the sheds it is conveyed in carts and so dumped that it feeds itself between a set of steel rollers. These grind enough clay to make 24,500 brick every ten hours. After being ground the clay is elevated to the top of the building and passed through a disintegrator and two rotary or revolving screens. From the latter it descends into a perpendicular

"mixer box" eight feet in diameter, where it is acted upon by revolving iron arms, and reduced to as nearly a homogeneous mass as possible. From the mixer it passes into a five-die hydraulic press of the Company's patent and make. This subjects it to a pressure of 2,750 pounds per square inch. Three such presses, each capable of making 24,500 brick daily, are in the plant, and connected with each of these is a set of steel rollers, disintegrators, screens, etc., as noted above. Besides these there is a press for making brick of special shape, which has but two dies and makes but 2,500 brick daily.

From the presses the brick are wheeled on trucks to the kilns. These are of the "Groves" pattern, and 14 in number, each holding 130,000 standard-sized brick. The kilns are so connected with one another and with a system of large exhausters or "blowers" that as soon as one is filled and hermetically sealed, the cold air which it contains is drawn off, and hot air from a freshly burned kiln rushes in to take its place. In this way much heat is used for drying which would otherwise be lost. After drying for one week the brick are burned, with crude oil as fuel, for an equal length of time. The oil burners used are an especial invention of Mr. Soper, the Superintendent of the company. Sixteen of them are used in each kiln, and it is claimed that they effect a great saving of the fuel. The advantages of oil as a fuel are well shown in such a large plant. A great saving of labor and time is effected, and a product free from dust, ashes, smut or discoloring matter of any kind is obtained. From the kilns the brick are taken to the stock room, 710 feet long, 33 feet wide and 14 feet high, where several millions of front brick of many colors, as well as large supplies of "special shape" brick, are kept constantly on hands. A double railway track runs through this room, so that the brick can be loaded from either side with ease.

Nine different shades of red brick are made and three of brown, the latter color being produced by mixing a salt of manganese with the clay as it enters the steel rollers to be crushed. About 100 different forms of "special shape" brick are made, one or two of which are sold as high as 65 cents each. The patterns or dies for each of these are owned by the company, and are kept in a separate fire-proof building. The amount of capital invested in the plant is about \$300,000.

One-half a mile east of the pressed-brick factory, the Chicago Brick Company are making soft mud brick in large numbers for the Chicago and other markets. These brick are made from the same stratum of fine grained, buff clay as are the pressed brick. At the pit this clay is ten feet in thickness and overlies the same kind of blue, marly clay as occurs at Hobart and Garden City. The brick are made on a Martin

machine at the rate of 35,000 daily for six months in the year. They are dried on pallets in sheds and are burned in permanent clamp kilns, of which seven, with a total capacity of 2,150,000, are in use. Wood is used for water-smoking and oil in burning, the two processes requiring twelve days.

One miles northeast of Chesterton, P. E. Anderson & Sons have been making brick and tile for ten years. For seven years the brick were made by hand, but since 1894 a Brewer brick and tile machine has been in use. A section of the pit at this yard is as follows:

1. Soil and surface—stripped..... 6 inches.
2. Yellow coarse-grained clay..... 5 feet.
3. Bluish marly clay with a few lime pebbles.....20 feet.
4. Bluish-gray marly clay, free from pebbles, pierced
by bore35 feet.

The uppermost clay burns to a bright cherry red color, and makes a brick far above the average in quality. The next stratum, No. 3, burns pink and is mainly used in tile making. The lower stratum, No. 4, is very similar to the clay found at Hobart and burns to a cream color. An analysis of a mixture from strata Nos. 3 and 4 resulted as follows:

ANALYSIS OF BLuish GRAY CLAY AT CHESTERTON, INDIANA.

	<i>Per Cent.</i>
Silica	53.02
Titanium oxide	1.30
Alumina	10.72
Combined water	2.21
<hr/>	
Clay-base and sand	67.25
Ferric oxide	2.54
Ferrous oxide	2.22
Lime	8.38
Magnesia	5.28
Potash	3.25
Soda .....	.86
<hr/>	
Fluxes	22.53
Carbon dioxide	10.48
<hr/>	
Total	100.26

The products made at this factory are dried in open air sheds and burned with wood. The brick are sold at the yard for \$4.50 to \$5.00 per thousand, and the four-inch tile at \$11.00 per thousand. The clays

are suited for the making of pressed front brick, terra cotta and fire-proofing. The blue marly clay is said to outcrop near City West in section 18 (37 north, 5 west), and also at the overhead bridge across the Michigan Central Railway one mile north of Chesterton.

THE CLAYS AND CLAY INDUSTRIES OF LAPORTE COUNTY.

Laporte County is in the third tier of counties from the western line of Indiana, and lies adjacent to the south border of the State of Michigan. Its northwestern corner is bordered by the shore of Lake Michigan for a distance of seven miles. The Kankakee River, flowing southwest, forms the larger portion of its southern boundary and receives from the county Mill Creek and several small tributaries. The area of the county is 562 square miles. Of this the northern third is somewhat broken and hilly and was formerly covered with timber. The central and southern portions contain about 200 square miles of fine prairie and a large area of Kankakee marsh land, much of which has been drained, and now forms excellent grazing and farming lands.

Numerous small lakes are scattered over the central or morainic portion of the county, and add much to the beauty of its scenery. The largest of these are Pine, Clear and Stone lakes, just northwest of Laporte, the county seat.

The limited time at my command allowed me to examine only the clays in the vicinity of Michigan City. Along Treaty Creek, northeast of that city, large deposits of an excellent bluish-gray marly clay come to the surface. Two miles east of the city Roeske Bros. have, a short distance from the creek, an extensive plant for the making of soft mud brick from a deposit of this and other clays. A section at their pit in September, 1897, showed as follows:

1. Soil 6 inches.
2. Buff sand 3½ feet.
3. Reddish "loam" 2 feet.
4. Yellow marly clay 2½ feet.
5. Bluish-gray clay 16 feet.

After stripping the soil and a portion of the sand, the remainder, down to No. 5 of the section, is used in making red brick. The "loam," No. 3, can be used for lining ladles, etc., in iron furnaces. The same material is shipped in quantity to Chicago from near McCool, Porter County.* The layer of bluish-gray clay has been pierced by a bore to the depth of 40 feet without reaching its bottom. It burns to a whitish or cream color, and two-thirds of the output of the factory

*See page 71 of this volume.

are from it alone. The deeper the point from which the clay is obtained, the stiffer and more tenacious it is, and the better the quality of brick made from it. The following analysis of this clay, made by Dr. Noyes, shows its constituents to be practically the same as the deposit so extensively worked at Hobart for fire-proof products:

ANALYSIS OF BLUISH GRAY CLAY FROM MICHIGAN CITY, INDIANA.

	<i>Per Cent.</i>
Silica	50.47
Titanium oxide	1.45
Alumina	12.77
Combined water	3.14
Clay-base and sand.....	67.83
Ferric oxide	2.44
Ferrous oxide	2.52
Lime	8.17
Magnesia	5.22
Potash	8.70
Soda .....	.73
Fluxes	22.78
Carbon dioxide	9.80
	9.80
Total	100.41

In the making of brick the clay, after being weathered for some time, is passed through a crusher, and then through a horizontal pug-mill, after which it is elevated by a belt-carrier to the top of a soft-mud machine. The brick are dried in sheds and burned in a peculiar "continuous" kiln. This kiln is divided into sixteen chambers, each capable of holding 16 to 17 thousand brick. After the fire is once started, the fuel, which is screened coal, is put in at the top of the chamber instead of at the bottom. Each chamber is connected by pipes with the ones adjacent to it, and the heat passes from chamber to chamber and "water-smokes" or dries the brick. In this way little heat is lost and the brick are burned for about 35 cents per thousand. Hocking Valley coal is used, costing \$2.80 per ton at the plant, as it is claimed that Indiana coal is too dirty. Aside from their color, the brick made from the blue clay at this factory are of most excellent quality. When burned very hard they become a greenish cast and are then used for paving alleys, sidewalks, etc., and are sold at \$8.00 per thousand, delivered. The ordinary quality bring \$6.00 per thousand at Michigan City. Four and one-half millions of both grades were made in 1897.

As already noted, the same clay as is used by Roeske Bros., outcrops in quantity along Treaty Creek. The L. E. & W. Railway runs over some of the best deposits. There is thus room and excellent facilities for the erection in this vicinity of several large factories for the making of fire-proofing, terra cotta, pressed front brick and other products. Too high a percentage of fluxes are present for its utilization in making sewer pipe, paving brick and similar vitrified wares.

THE CLAYS AND CLAY INDUSTRIES OF ST. JOSEPH COUNTY.

St. Joseph County lies east of Laporte and is bounded on the north by the State of Michigan. It comprises an area of 477 square miles, the surface of which is diversified by prairies, marshes, "oak openings," and rolling timber lands. The "oak openings" are covered with a light sandy soil excellently suited to the raising of small fruits; the timberlands possess a subsoil of clay, covered with a rich dark soil, which under proper cultivation and rotation of crops, yields all the cereals in abundance. The prairies, both old and young—for the marshes are but incipient prairies—where properly drained, are unexcelled for the raising of any farm product except wheat, which in places winter-kills.

The Kankakee River rises about two miles southwest of South Bend, and flows in a southwesterly direction through the county. The most of the marsh land adjacent to it has been or is being drained. The St. Joseph River is the principal stream within the county; entering it a little north of the middle of the eastern boundary, flowing westerly about ten miles, and then northerly into the State of Michigan. On its great bend to the northward is the flourishing city of South Bend, possessing a population of almost 30,000, and noted for its manufactures, especially wagons and plows, which are shipped to all portions of the world.

The clays of St. Joseph County, which have been found the best suited for manufacturing, are in the immediate vicinity of South Bend. Along the St. Joseph River are thick deposits of a pearl-gray marly clay, exceedingly fine grained and plastic, which for many years has been made into light yellow building brick, or, when burned harder, into a darker, greenish-yellow paving brick. In the eastern part of the city, near the west bank of the river, C. Soens & Co., have been making these brick for a number of years. In October their pit was quite deep, and was partially filled with water, so that it was impossible to obtain a section of the most recently worked portion. On the western side the strata were as follows:

1. Soil 8 inches.
2. Sand, coarse-grained, reddish, impregnated and discolored with iron oxide..... $4\frac{1}{2}$ feet.
3. Gravel 3 feet.
4. Sand—gray 3 feet.
5. Clay, bluish-gray 15 feet.

From this bluish-gray clay, which in places is 50 feet thick, the brick are made. The deposit was evidently laid down in still water since it is wholly free from pebbles. Aside from the heavy stripping, which is a great draw-back to securing it in proper quantity, the clay is well suited to the uses to which it is put. In places small pockets of so-called "quicksand" occur, which lessen to some extent its value. The lower half of the clay stratum is better suited for burning the hard brick used for paving purposes. The clay effervesces very freely with acids, and probably contains 10 to 15 per cent. of the carbonates of lime and magnesia.

In the making of the brick the clay is first passed through a Wallace crusher and pug-mill, then through a Penfield stiff-mud, plunger machine, with a Freese "side-cut" attachment. They are dried on pallets and burned in temporary kilns, with both wood and coal for fuel, the former for water-smoking. The burning of ordinary brick from this clay requires about six days after the water-smoking process is finished. If paving brick are desired, about 48 hours longer are necessary. When burned the shorter time the brick in a large kiln appear of four different shades. The three or four outside layers are pinkish red; the next four or five a darker red; the next six or eight are yellow, while those in the center of the kiln are greenish-yellow and are said to be "vitrified," though not to the extent as are the average paving brick made of shale. Besides being darker in color, the brick from the center of the kiln are much smaller, being but $2\frac{1}{2} \times 3\frac{3}{8} \times 7\frac{3}{8}$ inches, as against $2\frac{1}{2} \times 4 \times 8\frac{1}{2}$ inches, the size of the standard building brick from the outer layers.

The output of the Soen's yard is about 25,000 daily for $5\frac{1}{2}$ months in the year. The building brick bring \$5.25 and the paving brick \$7.50 per thousand delivered in the city.

On the east side of the river, about one-half mile north of the Soen's yard is another large yard owned and operated by Leeper & Longley. Their clay pit is in the second bottom or terrace of the St. Joseph River, and a section exposed in October, 1897, was as follows:

1. Soil 8 inches.
2. Sand and "loam" 4 feet.
3. Coarse gravel $4\frac{1}{2}$ to 7 feet.
4. Bluish-gray marly clay 18 feet.

The clay has been proven by bores to be 50 feet thick. Brick made by this firm in 1888 were used in paving two blocks of a street that has been much used for nine years, and shows as yet but few signs of wear. Round down-draft kilns have been tried in burning the pavers, but did not prove satisfactory. The output is mainly a cream-colored, side-cut, building brick, made on a Penfield plunger machine, dried in an open yard, and burned with wood. Oil has been tried as fuel, but the claim is made that it stained the brick and so lowered their price. This yard, in 1897, had an output of three million, most of which were sold in South Bend.

The blue clay used by these yards ranges from 30 to 50 feet in thickness. It evidently covers a large area, since it overlies a bed of gravel, from which is secured the water supply of the city. The clay forms an impervious cover for this water-bearing stratum, and when pierced the water rises from two to ten feet above the surface. At the site of the old "Water Works" in the eastern part of the city, 32 wells have been put down 112 feet deep. An average section of these wells is as follows:

- | | |
|------------------------|----------|
| 1. Soil and sand | 12 feet. |
| 2. Blue clay | 40 feet. |
| 3. Sand | 40 feet. |
| 4. Gravel | 20 feet. |

At the new Water Station, on North Michigan Street, are thirty wells, the average section of which is:

- | | |
|------------------------|----------|
| 1. Soil and sand | 14 feet. |
| 2. Gravel | 3 feet. |
| 3. Clay | 30 feet. |
| 4. Sand | 22 feet. |
| 5. Gravel | 14 feet. |

The brick made from this blue clay are hard, tough and durable. If the proper kilns and other facilities were erected, paving material of good quality could doubtless be made from it; but it is better suited for terra cotta, fire-proofing, flue linings and those numerous other products for which the ever increasing number of fire-proof buildings is creating a constantly growing demand.

About two miles southwest of South Bend are three factories which make soft-mud brick from a buff, porous, loamy "drift clay." This material, to a depth of four to seven feet, is free from carbonate of lime or lime pebbles, and burns to a handsome dark red. The brick made from it are hard, tough and durable, and above the average of those which go into the inner and side walls of buildings. The clay covers a large area in sections 21 and 22 (37 north, 2 east), being found on the surface of a ridge which rises 30 to 40 feet above the Kankakee marsh-land to the northward.

At the yard of Frank Fisher, in section 22, the clay used averages four feet in thickness and overlies a darker clay which contains pebbles of lime. Beneath the latter is the characteristic blue clay of the region. One-half mile southwestward, at the yard of John H. Shank, the porous buff clay is almost eight feet in thickness, and overlies a "hard pan" three feet in thickness, containing numerous pebbles. Beneath the latter is a bed of sand of unknown thickness. The three yards in this locality use soft-mud machines, dry on pallets and burn with wood. Their combined output in 1897 was about three millions, which were sold in South Bend at \$5.50 per thousand. The buff clay is not suited for the making of drain tile, nor was I able to learn of any such tile being made in the county.

THE CLAYS OF JACKSON COUNTY.

At the earnest solicitation of Hon. Louis Schneck of Seymour, and several other gentlemen who were desirous, if possible, of locating a deposit of clay suitable for vitrified wares in Jackson County, I spent several days in the early part of July in an investigation of the clays along or within a few miles of the lines of the B. & O. S. W. and E. & R. railways, in that county. These lines of railway cross the county from east to west and pass through the only portion of it in which there is any likelihood of such clays being found close to the surface in commercial quantities.

Jackson County lies in the southern third of the State and about midway between its eastern and western borders. It comprises an area of 490 square miles. The East Fork of White River enters the county three miles west of its northeastern corner, and flowing southwesterly, divides its area into two triangular shaped districts, which are very unlike in their topography, and in the character of their soils. In the southeastern district the surface is mostly rolling, with low sandy hills 50 to 100 feet in height. The northwestern district is very broken, and is traversed by a number of ridges which rise from 250 to 300 feet above the plains of White River, and trend in a northeasterly and southwesterly direction. In places these spread out into broad table-lands, which possess a sub-soil of clay.

Few counties in the State can boast of better agricultural resources than Jackson. About three-fourths of its area is composed of table-land and river bottom and one-fourth clay land and sandy loam. No better crops of corn, oats and melons are produced in Indiana than are grown on the first and second bottom lands of White River west of Seymour; while the sandy loam soils of the southern part of the county are especially adapted to the raising of peaches and grapes.

The clays of Jackson County which are sufficient in quantity and of suitable quality for extensive manufacturing are the Knobstone shales which outcrop along White River southwest of Seymour and on the sides of a number of the ridges west and northwest of that city.

On the roadside, one-fourth mile east of White Creek, in the northwest quarter of section 32 (7 north, 5 east), is an outcrop of grayish soapstone or argillaceous shale, very fine grained, wholly free from grit, and, where weathered, very soft and plastic. It is overlain by a boulder clay from three to ten feet in thickness, from which it is separated by a thin stratum of carbonate of iron. This shale deposit is about three miles north of the E. & R. Railway. There is no doubt but that it could be made into paving brick of excellent quality. It will also make pressed front brick, roofing tile and sewer pipe.

One-half mile farther west, in the northeast quarter of section 31 (7 north, 5 east), on the farm of Hon. L. Schneck, a brick and tile factory has been in operation since 1893. The brick are made from a buff loamy clay, evidently of glacial origin, the deposit of which covers 30 or more acres to a depth of 13 feet and overlies a stratum of sand, 12 feet in thickness. But five feet of the clay are used, since below that depth lime pebbles appear. These are not so many, however, but that they could be crushed with a dry-pan, and their harmful tendencies thus destroyed.

From this clay end-cut brick have been made on a Frey-Sheckler auger machine, which were used for paving alleys and street crossings in Seymour several years ago. They have since been subjected to much heavy traffic but show as yet no signs of wear.

A square down-draft kiln has been used in burning these brick and a handsome dark glaze was formed on their surface without the use of salt or other artificial substance. By mixing this surface clay with the above mentioned shale, one-half mile distant, in the proportion of two parts of the former to one of the latter, and then making the brick on a side-cut machine and burning in a standard round, down-draft kiln, there is little doubt but that paving brick of unexcelled quality would result. At present, however, the deposit is too far from transportation facilities and fuel to carry on the business on an extensive scale.

A deposit of true argillaceous shale, suitable for vitrified products, outcrops on the roadside in the southeast quarter of section 1 (6 north, 4 east), one mile west and two south of the brick factory above mentioned. It is ten feet in thickness where exposed and is overlain by boulder clays.

West of the Station of Surprise, in the northwest quarter of section 9 (6 north, 4 east), there is an exposure of Waverly or "Knobstone"

shale in a ravine a few rods south of the E. & R. Railway. This bed of shale covers a large area in the ridges to the south and is capped with a thin covering of soil, boulder clay, iron carbonate and geodes. The exposure is 15 feet in thickness, but the total thickness of the deposit was not determinable. It weathers into a soft, plastic, grayish clay. One hundred yards farther west the same shale is cut to a depth of 17 feet by the railway and is overlain with three feet of a mixture of the materials above noted.

One mile a little south of west of the above exposure, and 150 yards south of the railway on the land of John W. Lucas, east one-half of section 7 (6 north, 4 east), a bold bluff of the Knobstone shale rises 40 or more feet above the water of Salt Creek at its base. In this bluff are four parallel layers of large concretions of ironstone (siderite). One of these layers was three feet above the surface of the water on July 10th, 1897. Six feet higher was a second; eight feet higher a third, and two feet higher the fourth. Some of these concretions were flat, several feet across, and six to ten inches thick. Between these layers of ironstone the shale weathers in small quadrangular blocks.

This "knobstone" shale is called "soapstone" by the residents in that vicinity. The term "soapstone" rightfully belongs to the mineral steatite or talc, a magnesium silicate which does not occur in Indiana. However, the term is applied, in most parts of the State, to a very soft, fine-grained argillaceous shale, which is unctuous or greasy to the touch. The Knobstone shales, if properly weathered and then ground fine, will be found in every way suited for making vitrified products. In the bluffs above mentioned, and in others farther down the stream in the same and adjacent sections, they are found in practically inexhaustible quantities. Their proximity to a railway and to a good supply of water cannot be excelled. The only thing lacking is a fuel supply, which can be readily and cheaply obtained from the coal regions to the westward through which the railway passes.

South of Freetown, in sections 18, 19 and 30 (6 north, 4 east), many outcrops of the Knobstone shale occur in the hillsides. In general they are overlain with layers of geodes and ironstone clays. The latter, when exposed for some years to rain and frost, weather into small, quadrangular, brownish pieces called "creek gravel." This is often used in repairing roads, since but little true drift or water-worn gravel is found in the region.

Taking into consideration its location, quantity and quality, the best deposit of shale in Jackson County for vitrified products is at a point called "Blue Lick" on the south side of the B. & O. S. W. Railway in

the northeast quarter of section 6 (5 north, 5 east). The deposit is 50 or more feet thick, and consists of a soft, fine-grained, argillaceous variety of the Knobstone shale. It is wholly free from grit and lime impurities, contains but few concretions of ironstone, and weathers into a soft, unctuous, plastic clay. It outcrops along the ridge for a distance of several hundred yards and forms the main body of the ridge throughout its full width. The railway formerly ran at the very foot of the outcrop, but the shale weathered and fell down over the track to such an extent that the latter had to be moved several rods to the north. A railway switch can be put in with little expense, and cheap fuel can be obtained from the coal mines of Daviess and Knox counties.

Believing that this deposit of shale was in every way worthy of utilization for paving brick, I had a chemical analysis of it made by Dr. Noyes. The results of that analysis are here given side by side with those of an analysis, by the same chemist, of an average sample of the material used in the making of paving brick by the Wabash Clay Company of Veedersburg, Indiana, whose output is of excellent quality and the largest in the State.

**ANALYSES OF SHALES FROM "BLUE LICK," JACKSON COUNTY, AND FROM
VEEDERSBURG, FOUNTAIN COUNTY, INDIANA.**

	BLUE LICK. <i>Per Cent.</i>	VEEDERSBURG. <i>Per Cent.</i>
Silica	59.64	59.55
Titanium oxide	1.05	1.00
Alumina	19.14	16.21
Combined water	4.36	5.62
Clay-base and sand	84.19	82.38
Ferric oxide	3.39	2.18
Ferrous oxide	4.20	7.13
Lime .....	.26	.75
Magnesia	2.31	1.58
Potash	3.53	2.81
Soda .....	.80	.28
Fluxes	14.49	14.73
Carbon dioxide .....	.35	3.15
	.35	3.15
Total	99.03	100.26

From these analyses it will be seen that the Blue Lick shale contains almost three per cent. more alumina, and is, for that reason, that much stronger and better than the one from Veedersburg.

In the report on the "Clays and Clay Industries of the Coal-bearing Counties of Indiana," published in the 20th Annual Report of this Department, the *average composition of the shales* used by *ten* of the leading paving brick and sewer pipe factories in Ohio was taken as a *standard of comparison* for the composition of Indiana shales suitable for vitrified products. That average showed the presence of

Clay-base and sand	84.78 per cent.
Fluxes	13.22 per cent.

By comparing with this average the composition of the "Blue Lick" shale as follows:

Clay-base and sand	84.19 per cent.
Fluxes	14.49 per cent.

we find a *very close* approximation to the standard of comparison and prove the chemical fitness of the shale for the making of paving brick and sewer pipe.

Edward Orton, Sr., in a paper on "The Clays of Ohio, Their Origin, Composition and Varieties,"* speaks of the division of the Waverly shales of that State which correspond to the Knobstone shale of Jackson County "as a great stratum 160 to 450 feet in thickness, consisting of light colored blue or gray shales that have unlimited possibilities of service in the practical way, but which have been almost completely ignored thus far. Their day, however, is sure to come. Their adaptation to paving block manufacture in particular will be recognized and it will be at once shown as soon as it is used that no better material for this purpose is found in our entire series than this shale can supply."

The use of brick for paving streets and roadways has as yet hardly begun in Indiana, yet, between 1890 and 1896, twenty-seven towns and cities (not including Indianapolis) of the State expended for paving brick and block alone \$884,667, and for brick pavements \$2,416,131. Of the sum expended for the pavers, no less than \$647,022 were sent to the States of Ohio and West Virginia for brick, every one of which could have been made in Indiana and laid down at a handsome profit in the cities using them, for a less price than they were shipped in from other states.

At Seymour, several million brick have been brought from Ohio and laid down in the streets. These cost from \$10.00 to \$14.00 per thousand. The raw material for making them was to be found in abundance by the side of a railway within six miles of the spot where they were used. The extra amount paid for transportation of these brick would

* Geol. Surv. of Ohio, VII, 1893, 58.

have paid for a good plant for manufacturing them which, in the future, would have furnished labor for many hands. No paving brick factory exists at present in southern Indiana, except the one at Evansville. All the towns of that region of a thousand or more inhabitants, will within ten years, use brick for paving their leading streets. No cheaper or more durable pavement can be put down. All things considered, no better point exists for locating the factory to supply the brick for these future pavements, than at "Blue Lick," in Jackson County.

REMARKS ON THE CLAY ANALYSES.

The following analyses of clays were made especially for this report by Prof. W. A. Noyes, of the Rose Polytechnic Institute, of Terre Haute, Indiana. The analysis is, in each case, based on the substance dried at 135° C. The portions marked insoluble were found to be insoluble in acids and sodium carbonate.

No. 1. Average of the material used in the making of terra cotta lumber at Hobart, Lake Co., Indiana. See p. 128.

No. 2. Average sample of the upper portion of the bed of bluish-gray marly clay at Garden City, Porter Co., Indiana. See p. 133.

No. 3. Average sample of the bluish-gray marly clay from the pit of P. E. Anderson & Sons, Chesterton, Porter Co., Indiana. See p. 137.

No. 4. Average sample of the bluish-gray marly clay from the pit of Roeske Bros., Michigan City, Indiana. See p. 138.

Clays Nos. 1 to 4, inclusive, will be found in every way suitable for making terra cotta lumber, solid fire proofing, flue linings, foundation brick, under-roofing, column and girder covering, etc., etc.

No. 5. Average sample of Knobstone shale from "Blue Lick," Jackson Co., Indiana. Suitable for paving brick, sewer pipe, roofing tile and other vitrified products. See p. 146.

Chemical Analyses of Five of the Clays Mentioned in the Preceding Paper.

	1		2		3		4		5	
	Total.	Insol- uble.	Total.	Insol- uble.	Total.	Insol- uble.	Total.	Insol- uble.	Total.	Insol- uble.
Silica (SiO ₂)	50.56	31.35	50.37	35.62	53.02	35.21	50.47	30.20	59.64	30.22
Titanium Oxide (TiO ₂)	1.00		1.65		1.70		1.45		1.05	
Alumina (Al ₂ O ₃)	13.11	3.06	9.93	1.95	10.72	2.94	12.77	2.51	19.14	1.61
Combined water (H ₂ O)	2.76		1.50		2.21		3.14		4.36	
Clay-base and sand	67.43		62.45		67.25		67.83		84.19	
Ferric Oxide (Fe ₂ O ₃)	2.98		2.10		2.54		2.44		3.39	
Ferrous Oxide (FeO)	2.37		2.06		2.22		2.52		4.20	
Lime (CaO)	2.87		10.36		8.53		8.17		9.26	
Magnesia (MgO)	5.84		6.26		5.38		5.22		9.31	
Potash (K ₂ O)	3.71	2.14	3.04	2.35	3.23	1.65	3.70	1.38	3.53	.60
Soda (Na ₂ O)	.70		.79		.86		.73		.80	
Fluxes	22.67		24.50		22.53		22.78		14.49	
Carbon dioxide (CO ₂)	9.62		12.50		10.46		9.80		.35	
Total	90.72	39.55	99.45	39.92	100.26	39.80	100.41	34.09	99.03	32.43

Rational Analyses of Above Clays.

Quartz	23.61	28.78	24.80	21.39	25.57
Feldspathic detritus	15.94	11.11	14.91	12.70	6.86
Calcium carbonate	14.05	18.32	14.85	14.59	
Magnesium carbonate	6.54	8.48	7.60	6.42	0.67
Clay substance	39.86	31.28	37.71	44.90	66.90

Statistics of the Clay Industries of Northwestern Indiana.

NAME OF FIRM OR INDIVIDUAL.	LOCATION.	Capital Invested.	PRODUCTS.	MACHINERY USED.	How Dried.	Value of Output in 1897.	No. Hands Employed.	Average Daily Wages.	No. Months Worked.
Fowler Tile Works.	Fowler.	\$10,000	Drain tile.	Potts disintegrator and pug mill; Freese brick and tile machine.	In sheds with exhaust steam.	.....	15	\$1 45	7
Lochiel Tile Works.	Lochiel.	\$7,000	Drain tile.	"Adrian" brick and tile machine.	Sheds by air.	.....	13	\$1 25	6
Earl Park Elevator and Tile Co.	Earl Park.	\$20,000	Pressed brick, ordinary brick, and drain tile.	Potts disintegrator; 9-foot dry pan; "Little Wonder" brick and tile machine; Boyd & White brick machine.	On floors with steam.	\$7,000	20	\$1 25	7
John Lawson.	Oxford.	\$5,000	Drain tile.	Frankfort crusher; Hoosier tile machine.	Sheds by air.	\$3,500	4	\$1 30	6
Wm. Lawson.	Otterbein.	\$5,000	Drain tile.	"Little Wonder" brick and tile machine.	In sheds with steam.	\$3,500	8	\$1 30	7
Darrach Bros.	Morocco.	\$3,000	Drain tile.	Crusher; pug mill, and "Little Wonder" brick and tile machine.	In sheds by air.	\$1,500	8	\$1 25	7
M. E. Handley.	Beaver City.	\$4,000	Drain tile and brick.	Frankfort crusher; Hoosier brick and tile machine.	In sheds by air.	\$2,150	9	\$1 25	6
Stucker & Covert.	Mt. Ayr.	\$3,000	Drain tile.	Freese brick and tile machine.	In sheds by air.	\$3,750	6	\$1 25	6

J. H. Haynes Co.	Brook.	Terra cotta lum- ber; fire lining; solid fire-proof- ing; drain tile; ordinary brick, etc.	\$16,000	Crusher; pug mill; Adrian brick and tile machine.	In sheds by air.	\$15,000	16	\$1.50	7½
Goodland Tile Co.	Goodland.	Drain tile, hol- low brick and ordinary brick.	\$5,000	Crusher, pug mill and Adrian brick and tile machine.	In sheds by air.	\$3,000	12	\$1.35	7
A. E. & H. A. Alter.	Rensselaer.	Drain tile.	\$4,000	Potts disintegrator; New De- parture tile machine.	In sheds by air.	\$3,750	7	\$1.25	7
John Kohler & Son.	Rensselaer.	Ordinary brick and drain tile.	\$5,000	Freese tile machine; "And- er-Chief" brick machine.	In sheds by air.	\$3,500	10	\$1.25	7
A. C. Robinson.	Pleasant Grove.	Drain tile.	\$2,500	Crusher, pug mill and "Little Wonder" brick and tile ma- chine.	In sheds by air.	\$2,300	7	\$1.25	7
Samuel Bowman.	Remington.	Drain tile.	\$5,000	Potts disintegrator; Adrian brick and tile machine.	In sheds by air.	\$3,375	6	\$1.25	7
P. D. Clark.	Lowell.	Ordinary brick and drain tile.	\$5,000	Crusher and "Little Wonder" brick and tile machine.	In sheds by air.	\$5,000	8	\$1.25	6
H. W. Wise.	Crown Point.	Common brick and drain tile.	\$2,500	Penfield brick and tile ma- chine.	Open yard.	\$2,500	9	\$1.25	6
Hobart Terra Cotta Lumber Co.	Hobart.	Terra cotta lum- ber; floor arch- ing; wall fur- ring, etc.	\$40,000	Pug mill; Adrian brick ma- chine; Vaughn & Taylor sewer pipe press.	Tunnel dryers with steam.	\$40,000	46	\$1.37	12

Statistics of the Clay Industries of Northwestern Indiana.—Continued.

NAME OF FIRM OR INDIVIDUAL.	LOCATION.	Capital Invested.	PRODUCTS.	MACHINERY USED.	How Dried.	Value of Output in 1897.	No. Hands Employed.	Average Daily Wages.	No. Months Worked.
Kulage Brick and Tile Works.	Hobart.	\$100,000	Pressed front brick.	Nine-foot dry pan; two "Challenge," and one "Triumph" brick machines.		Plant not completed.			12
Garden City Brick Works.	Garden City Ind.	\$30,000	Ordinary brick.	Crusher, pug mill and Chambers' stiff-mud, end-cut brick machine.	Tunnel dryers with steam.	\$6,250	14	\$1.30	4
H. Folsom.	Hebron.	\$1,200	Ordinary brick.	Quaker brick machine	Open yard.	\$600	4	\$1.25	6
Kenny Bros.	Hebron.	\$5,000	Drain tile.	Crusher, and A. C. Hockett tile machine.	Sheds by air.	\$1,188	4	\$1.25	6
Lambke Bros.	Valparaiso.	\$3,000	Common brick.	Potts disintegrator; Williams pulverizer, and Creager soft-mud machine.	Sheds and pallets.	\$7,500	20	\$1.57	4
Coovert & Cleveland.	Valparaiso.	\$2,500	Drain tile.	Two crushers; Ohio auger tile machine.	Sheds by air.	\$3,000	5	\$1.50	5
Chicago Hydraulic Press Brick Co.	Porter.	\$300,000	Pressed front and special design brick.	Three crushers, three disintegrators, four hydraulic brick presses.		\$175,000	75	\$1.50	12
Chicago Brick Co.	Porter.	\$15,000	Common brick.	Two pug mills, and Martin soft mud brick machine.	Sheds and pallets.	\$25,000	35	\$1.50	6

P. E. Anderson & Sons.	Chesterston.	\$5,000	Common brick and drain tile.	Brewer brick and tile machine.	In sheds, by air.	\$5,500	5	\$1 40	6
Roeske Bros.	Michigan City.	\$15,000	Common brick.	Crusher, pug mill, and Cramer soft mud machine.	Sheds and pallets.	\$20,000	35	\$1 37	6½
C. Soens & Co.	South Bend.	\$8,000	Common brick.	Wallace crusher and pug mill; Penfield plunger, side-cut machine.	Sheds and pallets.	\$12,000	22	\$1 37	6½
Leeper & Longley.	South Bend.	\$12,000	Common brick.	Pug mill; Penfield No. 10 plunger machine.	Open yard.	\$17,000	30	\$1 50	6
Frank Fisher.	South Bend.	\$4,000	Common brick.	"Anderson Chief" soft mud machine.	Sheds and pallets.	\$5,500	9	\$1 50	6
Edw. Perkins.	South Bend.	\$2,500	Common brick.	Quaker machine.	Sheds and pallets.	\$3,000	7	\$1 50	4
Jno. H. Shank.	South Bend.	\$6,000	Common brick.	Quaker machine.	Sheds and pallets.	\$7,500	14	\$1 50	6
Elmer F. Hoover.	LaPorte.	\$2,000	Common brick.	Hand made.	Open yard.	\$1,200	10	\$1 40	4

THE PETROLEUM INDUSTRY IN INDIANA IN 1897.

BY W. S. BLATCHLEY.

With the exception of a small output in Vigo County, all the petroleum produced in Indiana is yielded by the Trenton limestone of the Lower Silurian formation. The main field is very probably a continuation westward of that of Lima, Ohio, though as yet the connecting area between the two has not been located. This field, comprising about 400 square miles, lies northeast of the center of the State, in portions of Adams, Jay, Wells, Blackford, Grant and Huntington counties. Outside of this area, oil in commercial quantities was being produced on January 1st, 1898, near Peru, Miami County; Walton, Cass County; Rich Valley, Wabash County; Alexandria, Madison County; Washington Township, Delaware County, and Broad Ripple, Marion County. All of these minor productive pools were located in 1897, except the one at Broad Ripple, where one or two bores produced oil the year before. As predicted in my former reports, the main field is thus slowly but surely extending its borders to the south and west, and will eventually cover all, or the greater portion of the area now producing natural gas.

The petroleum of the Trenton limestone was formed in that rock many thousands of years ago, by the slow decomposition or destructive distillation of myriads of animals and plants which existed in the Silurian seas at the time the sediment of which the limestone was formed was being deposited. Those animals and plants were buried in vast numbers in that sediment, and by the waters above and the ooze around them shut off from the free oxygen of the air, and the decay ordinarily undergone by dead organisms was thereby prevented. It is a well known fact that if wood, coal or the body of any animal be placed in an air-tight retort and heated, a distillation will occur, and the object will be changed to gaseous, oily and solid matters. In the absence of heat a very long period of time will bring about the same results. By this is meant the process of "slow destructive distillation" above mentioned.

The Trenton limestone, when first formed, was a pure calcium carbonate, or carbonate of lime. In the course of time certain areas of the sea bottom, covered with the lime carbonate, were slowly raised

until they became higher than the others, and formed shallow basins, lagoons or bays. Some of these raised portions covered very large areas. Others were isolated or separated from the main area sometimes by a distance of 20 to 30 miles. The outline of all was irregular, with many indentations along the margins. In these more shallow portions of the Silurian seas the water became in time very briny and caused a chemical change in the rock. To the lime carbonate was added some magnesia from the brine, and a magnesia-lime carbonate called "dolomite" resulted. Wherever this change took place—which was only in the shallow, briny areas noted—the resulting dolomite was porous. This porous condition was due to the fact that the new crystals of dolomite were smaller than, and never entirely filled the spaces occupied by, the older crystals of lime carbonate.

Trenton limestone underlies the whole State of Indiana at depths varying from 348 feet below the surface at Lawrenceburg to 1,933 feet below at Auburn and 2,300 feet below at Evansville. Only a small proportion of this underlying Trenton was ever changed into dolomite or porous rock, and only in the porous areas are gas and oil found. There is absolutely no method of telling where the limestone is porous and where it is not, except by putting down a bore.

The Trenton in Indiana varies in known thickness from 470 to 586 feet, and the porous portion is found only near its upper part. It is useless to drill into it more than 70 feet, since, of the eight thousand and more bores which have been put down in the State no oil or gas has been found below that depth.

The surface of the Trenton limestone is not level as many people suppose, but is a series of alternating arches and depressions or ridges and valleys. The arches or domes are like inverted troughs and vary much in width and area, as do also the depressions between them.

Wherever gas and oil occur they will be found in a porous stratum in one of the arches or anticlines as they are called. If a bore happens to be put down and strikes a depression or syncline between the arches, salt water will invariably be found. If both gas and oil are present in a certain area, and the bore strikes the flank or side of the arch, oil will result. If the bore strikes the crest or dome of the arch, gas will flow. The cause of this is simple, being due to the arrangement of the three fluids according to their relative weights—the lighter gas having in the past risen to the highest portion of the porous limestone; the oil, being heavier than gas and lighter than water, having been stored in the intermediate and the heavier salt water in the lower level. The volume

of gas and oil accumulated in any field, will depend, therefore, upon the area and height of the anticline, and upon the relative thickness and degree of porosity of the dolomitic portion of the Trenton limestone.

Where a bore for petroleum has resulted in a good producing well, the level of the surface of the Trenton rock below tide should be carefully ascertained. This can be done only by running a transit level from the nearest point where the surface level is known, usually on a railway, to the surface of the bore. By subtracting the surface level of the bore from the depth at which Trenton limestone is first struck, the surface level of the latter will be obtained. In but few places in the State is Trenton found above sea level. Where so found the depth to Trenton will be less than the surface level of the bore, and should be subtracted accordingly.

The location of the first dozen or more wells in any area a mile or two square must of necessity be largely a matter of guess-work, but if the surface level of the Trenton in each bore, productive or dry, be carefully ascertained, the trend of the anticline and the approximate limits of the field or pool can be soon determined. Too much guess-work concerning the surface level of the spot on which the well is located has been done in the past. In a broken country it is difficult for any man to guess approximately at the relative levels of two points a quarter of a mile apart, and the new level should always be ascertained with instruments. Of course the surface level of the bore has nothing to do with the absolute height or surface level of the Trenton, or the absence or presence of the petroleum, but it has a great deal to do with the accurate *determination* of the surface level of the Trenton and therefore with the location of future wells. If a few thousand dollars had been spent in Indiana in past days in the careful determination of surface levels, it would have saved a few hundred thousand which have been sunk in dry holes.

At the main points at which petroleum is produced in Indiana, the surface level of the Trenton lies below sea level as follows:

Alexandria	45 feet.
Broad Ripple	105 feet.
Geneva	164 feet.
Keystone	128 feet.
Montpellier	107 feet.
Peru	210 feet.
Rich Valley	208 feet.
Van Buren	138 feet.
Walton, Cass Co.....	171 feet.

A fallacy which is possessed by many would-be operators is, that oil fields or pools run in lines, and that one field is connected with all others, the oil flowing from one to the other, through a continuous strip of porous rock. This may in part be true in the Pennsylvania oil regions, but it is wholly untrue in the Trenton limestone area of Ohio and Indiana. While all the so-called "pools" of that area are found in the Trenton formation, they are not necessarily connected,

Pools Not nor do they run in lines. A pool may be of any shape, and
Necessarily may lie in any direction from any other pool. Its bounda-
Connected. ries may be straight or sinuous; its area one square yard or one thousand square miles. If the conditions necessary for the storing of petroleum, namely a porous reservoir, located in a dome or anticline of the Trenton limestone, with an impervious cover above it and a water pressure below it, have been present in the past, the oil will very likely be found, whatever the shape, size or relative location as to other similar reservoirs. The operator can only sink his drill; he has no way of knowing before-hand what the result will be. He may pierce the center of the reservoir and get a 500-barrel well; he may strike near its outer rim and get a ten-barrel well—he may miss it altogether and get a dry hole. One thing he can rely upon if he strikes a productive well, and that is, that he is drawing upon a stored product which is not now being formed in the rock from which it is drawn, and that, therefore, he must eventually exhaust the stock from the immediate vicinity of his bore.

More or less salt water is found in all portions of the main field. A difference of only six to ten feet in elevation or depression of the surface of the Trenton defines oil and salt-water territory.
Salt Water Some of the best wells pump a large amount of salt water
in Indiana with the oil. The water seems to keep the pores of the oil
Field rock free from paraffine and other clogging materials, and a well producing four to ten barrels of water a day is preferred by many operators to one that produces oil alone.

Throughout the Indiana field an eight or ten inch drive pipe is forced down through the drift to the Niagara limestone. The salt water usually found in the Niagara is cased off by an iron tube $5\frac{1}{2}$ or $6\frac{1}{4}$ inches in diameter, which reaches to the soft blue Hudson River limestone underlying the Niagara. This second limestone and the Utica shale beneath it contain no water. The Trenton is everywhere overlain with the soft, dark colored Utica shale which forms an impervious cover through which neither gas nor oil can escape. From the bottom of this shale the drill passes at once into hard limestone. In the main

The Indiana Field Cheaply Operated. field the first "pay streak" is found at from 15 to 25 feet in the Trenton; and usually a "second pay" 10 to 12 feet lower down. A few feet below the second porous stratum salt water is usually found. The driller aims to go as near this as he can without tapping the stratum in which it occurs.

For a number of reasons a lease in the Indiana field can be operated as cheaply as any in the eastern United States. Chief among these are the following:

- (a) The wells are comparatively shallow, the Trenton limestone in most instances being struck at less than 1,000 feet.
- (b) It is seldom that more than 150 feet of drive pipe and 400 feet of casing are necessary.
- (c) On account of a comparatively level surface a large number of wells can be connected to and pumped with one power.
- (d) Gas for fuel or for running gas engines is usually plentiful.
- (e) Transportation facilities are excellent, a system of pipe lines permeating all parts of the main field.

But few extensions of any importance were made in the main Indiana oil field in 1897. The prevailing low price of petroleum prevented operations in territory which had been fairly well tested. The "wild-catters" gave most of their attention to the pools at Alexandria and Peru, where they hoped to strike something better than the main field promised. Moreover, all of the most promising prospective territory within or near the lines shown on last season's map was under lease, and the operators only aimed to protect property lines, leaving active drilling for the future when the price of the product shall have raised. In Jay County some good wells were drilled in the south half of section 7, the northeast quarter of section 8 and the north half of section 18 (24 north, 13 east), in territory which had not before been tested.

New Developments in the Main Field.

The Diamond Oil Company has had remarkable success with its lease on the A. H. Myers farm in section 30 (24 north, 12 east), Harrison Township, Blackford County. Of three wells put down in 1896 and nine in 1897, all have been good producers, starting out from 60 to 300 barrels per day. Their total production for the year was 75,000 barrels on the 184 acres, proving it one of the best leases in the main field. The Trenton is found at depths varying from 934 to 972 feet. Numerous bores have been put down on all sides of this lease, but they have for the most part proven dry holes or small producers.

No developments of importance were made in Adams County. In Wells County several good wells were located on the W. Pouless farm, in section 6, Jackson Township, which had before been undrilled. It is estimated by a conservative operator that the old wells of the county have had an average decline of 40 per cent. in output within the year.

In Grant County the only new developments have been in the north halves of sections 2 and 3, Van Buren Township, where some fair wells were completed by the Ziegler Oil Company.

In Huntington County a number of good wells were completed in the southwest corner of Jefferson Township, but the lines of the productive area were unchanged. Sections 27 to 34, inclusive, in Salamonie Township, will doubtless be found to be paying territory in the future—though one or two test bores have developed only salt water.

STATISTICS OF THE OIL INDUSTRY IN INDIANA.

The following table gives the production of petroleum in the United States from 1859 to 1896, inclusive, together with the average yearly prices per barrel:

Production of Crude Petroleum in the United States from 1859 to 1898 (Barrels).

Year.	Pennsylvania and New York.	Ohio.	West Virginia.	Colorado.	California.	Indiana.	Kentucky and Tennessee.	Illinois.	Kansas.	Texas.	Missouri.	Indian Territory.	Wyoming.	Total United States.	Average Yearly Prices per Barrel.
1859	2,000													2,000	\$0.50
1860	500,000													500,000	1.05
1861	2,113,609													2,113,609	1.05
1862	3,056,690													3,056,690	1.05
1863	2,611,309													2,611,309	1.05
1864	2,116,109													2,116,109	1.05
1865	2,497,700													2,497,700	1.05
1866	3,597,700													3,597,700	1.05
1867	3,347,300													3,347,300	1.05
1868	3,646,117													3,646,117	1.05
1869	4,215,000													4,215,000	1.05
1870	5,250,715													5,250,715	1.05
1871	5,205,234													5,205,234	1.05
1872	6,203,194													6,203,194	1.05
1873	9,803,785													9,803,785	1.05
1874	10,926,945													10,926,945	1.05
1875	8,787,514	6200,000	63,000,000		6175,000									8,787,514	1.05
1876	8,968,906	31,763	120,000		13,000									8,968,906	1.05
1877	13,135,475	29,888	179,000		15,227									13,135,475	1.05
1878	15,163,462	38,179	180,000		19,858									15,163,462	1.05
1879	19,685,176	29,112	180,000		40,552									19,685,176	1.05
1880	26,027,631	38,940	179,000		90,862									26,027,631	1.05
1881	27,376,509	33,867	151,000		128,636									27,376,509	1.05
1882	23,128,389	39,761	128,000		142,857									23,128,389	1.05
1883	23,772,249	47,632	126,000		282,000									23,772,249	1.05
1884	20,776,041	90,081	90,000		325,000									20,776,041	1.05
1885	25,798,000	650,000	102,000		377,145									25,798,000	1.05
1886	22,356,193	1,782,970	102,000		678,572									22,356,193	1.05
1887	16,488,668	5,018,015	145,000		690,333									16,488,668	1.05
1888	21,487,435	12,471,466	544,113		303,220									21,487,435	1.05
1889	28,458,208	16,124,656	492,578		368,842									28,458,208	1.05
1890	33,009,296	17,740,301	2,406,218		665,482									33,009,296	1.05
1891	38,422,377	16,392,921	3,810,086		824,000									38,422,377	1.05
1892	20,314,513	16,792,921	8,445,412		594,300									20,314,513	1.05
1893	19,019,980	16,792,921	8,445,412		705,969									19,019,980	1.05
1894	19,144,380	19,545,233	8,120,125		629,482									19,144,380	1.05
1895	20,584,421	23,941,169	10,019,770		1,292,777									20,584,421	1.05
Total.	537,241,681	157,284,942	47,199,374	4,458,525	7,936,678	16,022,396	224,133	2,210	201,101	1,811	444	457	8,702	770,582,514	1.05

^a In addition to this amount, it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1882 from the Pennsylvania fields; also a large amount from West Virginia and Tennessee. ^b Including all production prior to 1876 in Ohio, West Virginia and California. ^c This includes all the petroleum produced in Kentucky and Tennessee prior to 1883.

From the above table it will be learned that the production of petroleum in Indiana gradually increased from 33,375 barrels in 1889, when the wells at Terre Haute first began yielding, to 4,680,732 barrels in 1896. In 1897, the production, for the first time, fell below that of the preceding year, the loss being 327,594 barrels, or very nearly 7 per cent. This decrease was mainly due to the prevailing low price of the product, which brought about an inactivity in drilling. As already noted, the production of the old wells in the main field fell off about one-third, and the total production for the year would have been much less had it not been for the new developments at Peru, Alexandria and other points.

In the following table is shown the total production in Indiana by months from 1891 to 1897, inclusive. The largest production in any one month is seen to have been in July, 1895, when 434,376 barrels were produced.

TOTAL PRODUCTION OF PETROLEUM IN INDIANA FROM 1891 TO 1897, BY MONTHS.

[Barrels.]

MONTH.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
January.....	6,171	15,841	111,824	259,000	300,568	365,582	290,746
February.....	5,981	18,946	96,025	232,107	230,559	341,743	309,922
March.....	5,159	24,794	134,549	282,376	310,303	386,586	341,961
April.....	4,973	26,184	146,493	287,330	352,077	395,032	328,779
May.....	5,757	31,033	186,239	321,502	397,001	417,963	340,023
June.....	8,136	40,888	209,616	333,479	403,569	434,167	369,803
July.....	10,809	49,203	221,666	327,349	434,376	432,968	375,249
August.....	11,603	56,109	248,353	345,031	420,132	407,238	371,921
September.....	16,500	66,034	245,615	319,588	409,169	415,675	362,528
October.....	19,029	95,699	252,568	339,434	393,153	394,283	408,179
November.....	20,801	129,270	245,907	304,030	373,789	337,331	430,958
December.....	21,715	144,067	236,038	337,450	361,435	362,164	423,069
Total.....	136,634	608,068	2,335,293	3,088,666	4,386,132	4,680,732	4,353,138

It will be noted that the production in each of the winter months is less than in those of spring or summer. This is usually the case, there being, during the cold season, fewer wells drilled in and a smaller yield from those already finished. The shipments are greater than the production in winter and the price usually rises a few cents per barrel.

In the following table will be found a statement of the production of petroleum in Indiana from 1889 to 1897, inclusive:

PRODUCTION OF PETROLEUM IN INDIANA FROM 1889 TO 1897.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
Total production (barrels of 42 gallons)	33,375	63,496	136,634	696,068	2,335,293	3,688,666	4,386,132	4,680,732	4,353,136
Total value at wells of all oils produced, excluding pipe	\$10,881	\$32,462	\$54,787	\$260,620	\$1,050,882	\$1,774,260	\$2,807,124	\$2,954,411	\$1,871,849
Value per barrel	\$0.323	\$0.511	\$0.40	\$0.37	\$0.45	\$0.48	\$0.64	\$0.63	\$0.43

From the following table may be learned the number of wells put down in Indiana for oil in any month since June, 1891:

NUMBER OF WELLS COMPLETED IN THE INDIANA OIL FIELDS FROM 1891 TO 1897, BY MONTHS.

YEAR.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891							6	6	15	15	15	8	65
1892	11	13	18	13	17	19	17	30	25	52	33	47	286
1893	20	30	31	36	45	47	47	55	27	72	56	76	542
1894	90	103	103	80	110	107	84	123	100	107	97	85	1,189
1895	61	45	81	111	122	153	132	140	129	106	102	85	1,267
1896	76	90	86	136	148	151	113	121	70	57	66	66	1,180
1897	41	35	40	47	49		61	45	55	89	117	54	685
Total													5,223

This table shows that there was less activity in oil operations in Indiana in 1897 than during any year since 1893. On January 1st, 1898, there were 3,648 wells producing oil in the State, so that 1,575 of those completed had either proven dry holes or had ceased to yield oil in sufficient quantity to pay for pumping.

The following table gives the

TOTAL NUMBER OF DRY HOLES DRILLED IN INDIANA OIL FIELDS FROM 1891 TO 1897, BY MONTHS.

YEAR.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891							0	2	5	4	3	1	15
1892	2	6	6	2	3	4	2	3	3	18	6	21	76
1893	7	10	10	6	14	6	11	9	5	14	10	9	111
1894	19	14	24	14	13	13	9	21	15	14	8	17	181
1895	7	4	13	16	22	20	15	23	12	12	9	13	166
1896	10	13	6	28	26	20	14	19	4	4	6	8	158
1897	8	9	7	12	5	16	11	9	16	11	18	8	130

From the following table may be learned the

NUMBER OF PRODUCING WELLS AND NUMBER OF DRY HOLES DRILLED IN
EACH OF THE OIL PRODUCING COUNTIES OF INDIANA IN 1897.

COUNTY.	Producing Wells.	Dry Holes.	Total.
Wells	161	20	181
Blackford	47	23	70
Jay	34	19	53
Adams	29	13	42
Grant	43	1	44
Huntington	29	1	30
Madison	32	34	66
Miami	166	12	178
Marion	11	5	16
Delaware	3	2	5
Total	556	130	685
Total, 1896	1,022	158	1,180
Decrease	467	28	495

One feature of the oil industry which has come into common use, and which should be abandoned, is that of giving the initial output of a well rather than its settled production after 30 or 60 days. Because a well starts out at 100 or 250 barrels a day is no sign that its total production will be a large one. In general it may be said that a 50-barrel well will be down to ten barrels in two months, and to five barrels in a year. A well that has an initial production of 50 barrels is a fair average well for the entire Indiana field, the average production of which is about 3.7 barrels per well per day. A well that starts off at 150 to 250 barrels gets down to the average in time, the only difference being that the oil bearing stratum which the bore has pierced is a little more porous than in the one yielding 50 barrels.

The following table shows the

INITIAL DAILY PRODUCTION OF NEW WELLS IN THE INDIANA OIL FIELDS
FROM 1891 TO 1897, BY MONTHS.

[Barrels.]

MONTH.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
January		342	1,020	2,361	2,132	1,557	730
February		250	913	2,395	1,413	1,875	1,000
March		289	2,805	3,395	2,504	2,090	1,000
April		316	4,135	3,175	3,473	2,825	800
May		505	3,155	4,450	3,035	3,149	1,235
June		545	5,595	4,885	4,923	3,115	900
July	253	595	3,880	3,530	3,067	2,332	1,790
August	135	1,295	4,184	3,435	2,760	2,650	850
September	875	2,145	2,065	3,149	3,175	1,700	2,010
October	330	4,155	3,442	3,455	2,651	1,515	4,080
November	390	3,050	2,305	3,323	2,560	1,400	3,790
December	175	3,160	2,968	2,654	2,025	1,100	1,045
Average	360	1,387	3,038	3,396	2,810	2,109	1,607

THE ALEXANDRIA OIL FIELD.

On April 23d, 1897, a bore put down on the N. Carver farm, north-east quarter of section 17 (21 north, 8 east), two miles northeast of Alexandria, Madison County, developed a large amount of petroleum. It was a wild-cat bore put down by the Northern Lima Oil Company, and when first drilled in showed but little signs of oil. The Trenton limestone was struck at 890 feet and was pierced 100 feet, the drill passing through two streaks of porous rock with 28 feet of hard, non-porous material between them. The showing of oil was enough to cause the company to shoot the well on the date mentioned, when it at once began to flow about 250 barrels per day. Owing to a lack of tankage and pipe line facilities much of the first week's flow was wasted, but the Buckeye Pipe Line soon made connection with their loading rack at Alexandria, and took care of the product.

The drilling in of such a well awakened the lethargy which for a number of months had enthralled the oil operators throughout the Lima—Indiana field, and hundreds of them flocked to Alexandria and sought leases in the prospective territory. A number of bores were soon started, nine of which were completed in May. Of these, three yielded gas only, and the remaining six had a combined initial output of but 245 barrels of petroleum.

One of these wells, located on the Decker farm, about 20 rods west of the Carver well, showed but a trace of oil, but gave off a large amount of gas which for a time was allowed to escape. This opened up the great question of the waste of gas from oil wells, which has since been the subject of much contention between oil operators and the consumers of natural gas. This question is fully discussed by the State Gas Supervisor, Mr. J. C. Leach, in another part of the present volume.

In June, 11 additional wells were drilled in, but three of which yielded oil, and the remainder gas. One of the oil wells was located on the S. M. Peck farm, in the southwest quarter of section 23 (21 north, 8 east), about two and one-half miles southeast of the Carver well. It started out at 100 barrels, and on September 25th was producing about 60 barrels of oil and wasting 2,000,000 cubic feet of gas daily. Four bores have since been drilled on the same farm, one of which started at 25 barrels and another at 30, the other two being dry.

A second one of the wells, which was finished in June, created much excitement, for the reason of its location within the corporate limits of Alexandria, on a lot in the Hillside Addition. It had an in-

itial output of 50 barrels daily, but by mid-September was down to 10 barrels and a small flow of gas. This immediately started a town lot boom in that section of the city and a number of wells were drilled in, the most productive of which, known as the Stillwell No. 1, was finished July 1st, starting at 150 barrels, with a large accompanying waste of gas.

During July 12 bores were completed in the Alexandria field, five of which were dry. The seven producing wells had an initial output of 605 barrels, 400 of which were yielded by a single well on the W. P. Blake farm, east half of northwest quarter of section 16 (21 north, 8 east). This was one-third mile east of the Carver No. 1, and was the best well drilled near Alexandria in 1897. The Trenton limestone was found at 918 feet. Four other bores on the same lease started at 150, 125, 10 and 100 barrels, respectively. The first two wells soon began to yield large quantities of salt water, and by September 25th the No. 1 was producing 65 barrels of oil and wasting 1,000,000 cubic feet of gas daily.

Bores which were dry or yielded gas only were drilled on the W. P. Perry farm, one mile northwest of Alexandria, where the Trenton was found at 880 feet below the surface; also on the M. E. Tomlinson farm, one mile north; on the Wm. Carver farm, one mile west; on the Sharp farm, four miles southwest; on the Mary Nicson farm, one mile southwest, and on the Thomas Baxter farm, two and a half miles southeast, of Alexandria. Two bores, which furnished gas only, were also sunk on the Rosebaum and Vincent farms, near Summitville. These non-productive bores stopped the growth of the field to the north, west and south. With the exception of three or four, all bores sunk within the limits of the town yielded much gas and little oil, and but eight of them produced oil at all. Several bores which were put down between these town-lot wells and the Blake-Carver pool proved dry, and developments in the former locality came to a close.

During August and September 23 bores were finished, ten of which were dry, and the 13 producing had a combined output of only 425 barrels. The interest of operators was about this time transferred to the field at Peru, and during the last three months of the year but little drilling was done, and this only east and northeast of the original Carver well. This well, by September 25th, was yielding gas only, and a second bore put down on the same lease in December proved dry.

While the results in the Alexandria field have, up to the present, proven unsatisfactory, there is little doubt but that in the future its limits will be extended to the northeast, until it is connected with the main Indiana field. It would be far better, however, to postpone

drilling within the limits of the gas-producing territory until the supply of gas has been practically exhausted. The oil can be held in store and will not be wasted while the gas is being drawn off. It is worse than folly to waste the one while trying to secure the other. Wherever the two are found in conjunction, separators should be used and the gas piped to some main where it can be utilized. Such separators are on the market and their utility has been proven. Laws should be enacted giving the Gas Supervisor the right to shut off all wells where either of the two products is being wasted. By such means only can these two fuels be properly conserved and made to be of the greatest and most lasting utility to the people of the State.

The following are the statistics of the Alexandria field to January 1st, 1898. They were in part furnished by Mr. Leach, who has been actively engaged since June 1st in trying to shut off the waste of gas:

STATISTICS OF THE ALEXANDRIA OIL FIELD FOR 1897.

	<i>Wells Drilled.</i>	<i>Dry Holes or Gas Wells.</i>	<i>Production by Months.</i>
April	1	0	678 barrels.
May	8	3	1,171 barrels.
June	11	8	2,058 barrels.
July	12	5	6,487 barrels.
August	11	3	16,528 barrels.
September	12	7	11,072 barrels.
October	6	4	11,970 barrels.
November	3	2	10,326 barrels.
December	3	2	11,482 barrels.
Total	67	34	71,767 barrels.

Wells drilled for oil in Madison County in 1897.....	67
Wells that have produced oil in commercial quantities.....	20
Wells that produce gas in commercial quantities.....	35
Dry holes	8
Wells producing oil January 1, 1898.....	21
Wells allowing escape of gas January 1, 1898.....	17
Am't of gas wasting daily, Jan. 1 (estimate).....	20,000,000 cubic ft.
Daily oil production, Jan. 1.....	400 barrels.
Average production per well, Jan. 1.....	18 barrels.

Seven miles northeast of Alexandria, in section 36 (22 north, 8 east), Washington Township, Delaware County, several bores were put down in the fall of 1897, two of which yielded oil in commercial quantities. The first of these, on the Wm. Broyles farm, struck the Trenton limestone at 940 feet, the first pay streak at 1,010 and the second at 1,045 feet. The well was not shot, and started with a flow of 50

barrels. The second, on the Robert Livingston farm, three-quarters of a mile southwest, started at 150 barrels, after striking the Trenton at 937 feet. On the first of January Mr. Leach reported that the two wells were producing daily 125 barrels of oil and 3,000,000 cubic feet of gas; the latter being allowed to escape. On the Karus farm, near Matthews, five miles northeast of the Broyles well, a bore put down in December resulted in a dry hole; as did also one on the Vickery farm, a mile east of the Broyles well.

THE PERU OIL FIELD.

The greatest development of the Petroleum Industry in Indiana in 1897 was in the immediate vicinity of Peru, Miami County, about 35 miles northwest of the western end of the main field. Two hundred and twenty-nine wells were put down in this new field between August 15th and January 1st, and of these 178 have proven productive of petroleum in commercial quantities.

It had long been supposed that Peru lay outside of both the oil and gas areas of the State. This supposition was based on the fact that three wells were put down in the vicinity of that city in 1888—all of which yielded salt water, and but one of which showed signs of oil. The first of these was located on the E. A. Bearss land in the southeast quarter of the northeast quarter of section 28 (27 north, 4 east), in the north part of the city, and less than one-third of a mile due east of some of the most productive wells of the present season. The record of that well as given by S. S. Gorby* was as follows:

Alluvium—river drift	36 feet.
Niagara limestone	385 feet.
Hudson River and Utica.....	454 feet.
Top of Trenton.....	875 feet.
Total depth	905 feet.
Surface above sea level.....	657 feet.
Top of Trenton below sea level.....	218 feet.

In this well a small quantity of oil was found five feet below the top of the Trenton, and at 25 feet in Trenton salt water in abundance was struck.

The second bore was put down on the J. F. Miller farm in the southeast quarter of section 34 (27 north, 4 east)—south of the Wabash River and about one and three-quarter miles southeast of well No. 1. Its surface was 700 feet above sea level, and Trenton was struck at a depth of 929 feet, or 229 feet below sea level, showing a

*16th Ann. Rep. Geol. Surv., Ind., 1898, 184.

descent of 11 feet in the surface of the Trenton between the two wells. This, alone, was sufficient to show that oil would not be found in that direction south of the river, yet a number of bores were sunk the present season to try to prove the contrary.

A third bore was put down on the John Younce farm near the center of section 21 (26 north, 5 east), Butler Township. The Trenton was found at a depth of 960 feet, but the surface level was not determined, hence the record is of little value. A small quantity of gas was found at 970, and salt water, which filled the bore, at 1,000 feet.

The fourth and last well, until those of 1897, was located on the farm of A. C. Bearss in the southwest quarter of section 16 (27 north, 4 east), about three miles north of the center of Peru. The section at this well was as follows:

Drift	324 feet.
Niagara limestone	379 feet.
Hudson River and Utica shale.....	307 feet.
Top of Trenton.....	1010 feet.
Total depth	1041 feet.
Surface above sea level	757 feet.
Top of Trenton below sea level.....	253 feet.

This showed a decline of 35 feet in the level of the Trenton between wells No. 1 and No. 4, and should have proven the futility of farther boring in this direction.

No farther search was made for gas or oil until the spring of 1897, when 100 citizens of Peru organized the "People's Oil and Gas Company." Ten dollars each was subscribed and a bore put down on the B. E. Wallace farm south of the Wabash and just east of the Mississinewa River. No surface level was taken and no accurate record was kept of the well. No one seems to know the depth at which Trenton was struck, which was on June 29th. The bore proved a dry hole, and the contractor agreeing to drill another for \$500, the members of the company put up \$5 each and the second well was put down in the northwestern part of Peru, on a triangular piece of ground about one-third mile a little south of west of the first bore put down in 1888. This land belongs to W. N. Dukes, and lies just north of the Wabash Railway in the southeast quarter of section 28 (27 north, 4 east). The surface of this well was about 657 feet above sea level, and the top of the Trenton was reached on July 19th, at 855 feet, or 198 below sea level, showing a rise of 20 feet in one-third mile, providing the measurements were correctly made. Oil was found a few feet in the Trenton, and the well filled to the top and flowed a small but steady stream through the casing, yielding about 12 barrels per day for three

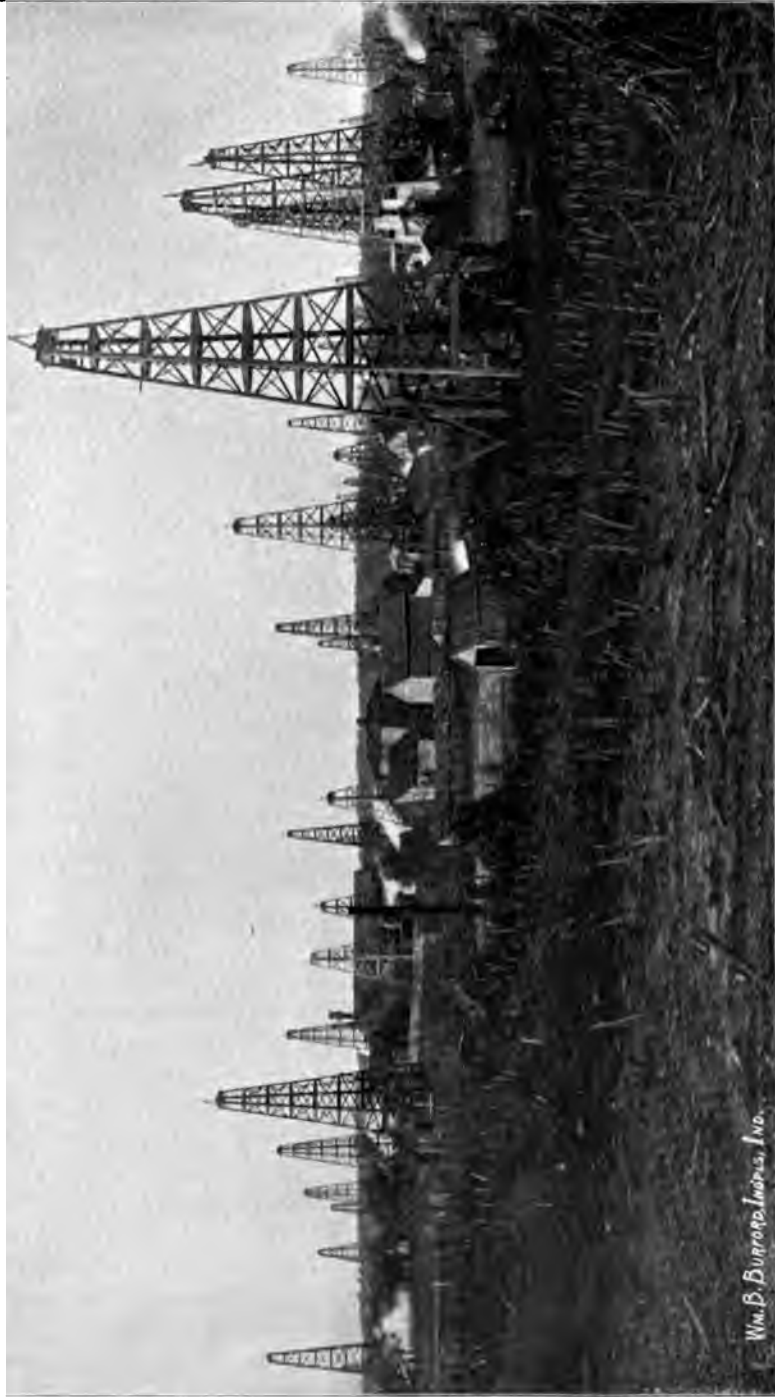
weeks. The well was then tubed and pumped and began yielding 120 barrels a day, which it kept up for a month or more. As this was the first oil ever found in the county it created no little excitement, and the company immediately began the sinking of two more wells on the same 16-acre lease. A number of new companies were organized, one of which, the Runyan Co., began sinking a well 400 feet east of the Dukes No. 1. These three wells were completed about the same date, September 10th.

In the Dukes No. 2, 350 feet southwest of No. 1, Trenton was struck at 844½, and when penetrated but three feet the bore filled with oil and overflowed faster than the product could be taken care of in barrels. The bore was finally sunk 25 feet in Trenton and tubed, and the well began yielding 175 barrels daily. The Dukes, No. 3, found the Trenton at 848½ and was sunk 21 feet deeper. It started at 150 barrels. The Runyan well pierced the Trenton at 850½ feet, and started with a yield of 140 barrels.

The opening of three new wells, each with an excellent yield, started an oil craze which ran riot through the town. Every citizen who could raise five or ten dollars joined an oil company, and most of the land within five miles of the city which could be leased at all was soon under contract. Old oil operators from the main field and from Alexandria flocked to Peru in droves, but found little choice territory unleased. Royalties of as high as one-fourth were asked and given, and it is even claimed that an over-sanguine farmer refused \$3,000 bonus and one-third royalty on a farm which was supposed to be near the heart of the field. Some of the newcomers secured the right of way along the Wabash and L. E. & W. railways, and derricks began to go up on all sides of the little triangular tract known as "the Dukes lease."

By the 25th of September more than 30 rigs were up and wells drilling within one-fifth of a mile of the four producing wells. Town lots were leased and square feet, rather than acres, were contracted for. The local operators, who knew little of the oil business, thought that all that was necessary was room enough to set up a rig and a boiler. Fancy prices were paid for town lots, and as the new wells began to come in as fine producers the craze grew apace, and stock which had cost the owners five to twenty dollars sold for \$250 to \$1,000, with more eager to buy than there were to sell.

Just north of the Dukes lease the surface rises about 50 feet and forms what is known as Hospital Hill. A number of the wells put down in the first half of October were located on this hill east of Dukes street, and all of them came in with handsome yields. The



Wm. B. Burrage, Inc., Ind.

A PORTION OF HOSPITAL HILL, PERU INDIANA, DECEMBER 1, 1897, SHOWING OIL DERRICKS ON TOWN LOTS.

best of these, and probably the best well in the entire field, was put down by the Crescent Co. on the Artis lot. A record of this well as kept by the superintendent of the company shows the strata pierced to be as follows:

Drift	20 feet.
Niagara limestone	375 feet.
Hudson River shales and limestone.....	255 feet.
Utica shale	248 feet.
Top of Trenton at.....	898 feet.
Total depth	933 feet.

This well was drilled in October 22nd, and produced 400 barrels of oil a day for four days. The production then dropped gradually to 100 barrels, which it was making November 12th, when three weeks old. An experienced operator from Findlay, Ohio, concluded that a well on an adjacent lot would produce as much. Normally the lot was worth \$200, but he paid \$1,500 for it and put down a well which started at 30 barrels daily.

On ten acres of land owned by the Peru Bagging Co., a short distance from the Artis well, six wells were put down which struck the Trenton at an average depth of 902 feet, and had an initial production of about 75 barrels each. The accompanying plate shows a portion of Hospital Hill as it appeared on December 1st, 1897, the bagging mill with its surrounding derricks being just to the left of the center of the view.

North of the Bagging Co.'s plant several fair wells have been drilled on the R. B. Runyan land; but two put down by the Ohio Oil Co. on the Rachael Zern farm, west half of southwest quarter of section 21 (27 north, 4 east), have yielded much salt water and but 20 to 25 barrels of petroleum.

Progress eastward was stopped by two bores, one a small producer, which was soon abandoned, on the E. A. Bearss land, about one-third mile east of the People's No. 1 and 500 feet west of the first well drilled in the county in 1888; the other a bore in North Peru (Godfrey Reservation No. 12), which found the Trenton rock at 867 feet, but proved barren.

South of the Wabash Railway, between Grant Street and the Peru Driving Park, a large number of good wells were put down in October and November by the Klondike, Peru and People's oil companies. In this region the Trenton rock was found between 850 and 860 feet, showing its surface to be from 200 to 215 feet below sea level.

South of the Wabash River a number of bores were put down, the location of each being given in the list which follows, not one of which

found more than a mere trace of oil. On the T. Riley farm, just north of the Driving Park, a well which never produced more than ten barrels daily stopped the growth of the field in that direction; while several dry holes farther northwest served to mark more definitely its boundaries.

By the first of December the limits of the territory producing oil in paying quantities were fairly well defined, as shown on the accompanying map, and active operations greatly decreased, since all the inside territory was under lease. The number of wells finished in November was 88, 38 more than in October. At the close of the month but 22 wells were being drilled, and in December but 28 were finished, none of which were non-productive.

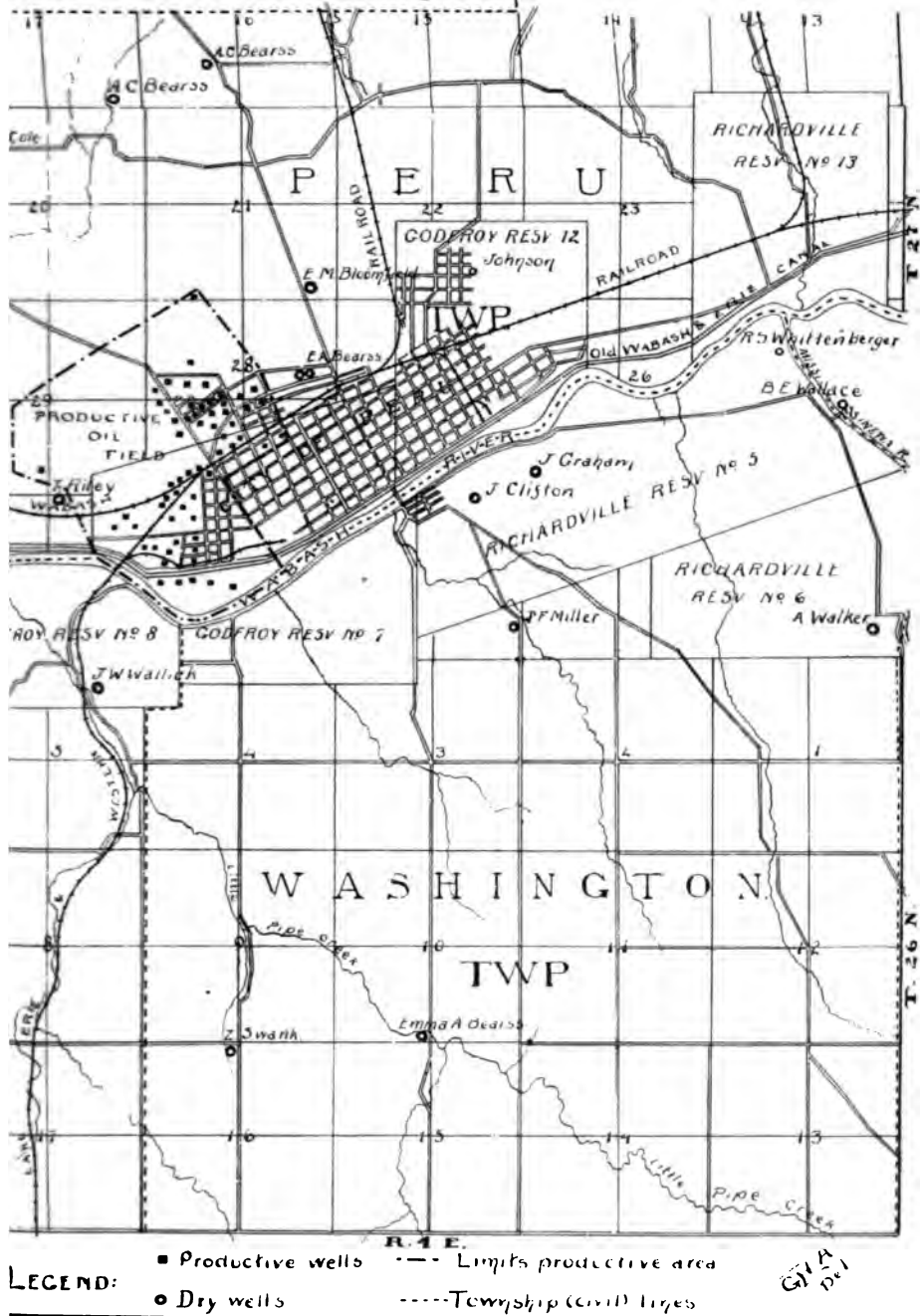
A list of the dry holes put down in Miami and adjoining counties which served to mark the boundaries of the Peru field is here given.

A LIST OF NON-PRODUCTIVE BORES FOR PETROLEUM IN MIAMI AND ADJOINING COUNTIES.*

<i>Owners of Land.</i>	<i>Location.</i>	<i>Depth to Trenton Limestone.</i>	<i>Approximate Depth of Surface of Trenton Below Sea Level.</i>
1. E. A. Bearss—	Southeast quarter of northeast quarter of section 28 (27 north, 4 east), Peru Township...	875	218
2. J. F. Miller—	Southeast quarter of section 34 (27 north, 4 east), Washington Township.....	929	229
3. Jno. Younce—	Northeast quarter of southwest quarter of section 21 (26 north, 5 east), Butler Township..	960	200
4. A. C. Bearss—	Southwest quarter of section 16 (27 north, 4 east), Peru Township	1010	253
5. B. E. Wallace—	Northwest corner Godfrey Reserve No. 9, Butler Township.....?	870	?200
6. E. A. Bearss—	500 feet west of No. 1, Peru Township...	870	213
7. B. A. Blair—	Southeast quarter of southeast quarter of section 19 (27 north, 4 east), Peru Township...	884	224
8. E. M. Bloomfield—	Southeast quarter of southeast quarter of section 21 (27 north, 4 east), Peru Township	866	206
9. ——— Johnson—	East part of North Peru, Godfrey Reserve No. 12, Peru Township.....	867	207
10. A. A. Cole—	Northwest quarter of section 20 (27 north, 4 east), Peru Township	870	200
11. Sarah Myers—	Southwest quarter of section 18 (27 north, 4 east), Peru Township	920	267

* Much of the data for this list was gathered and kindly furnished for this report by Messrs. Masterman and Chevront, of Peru.

ETCH MAP OF PERU OIL FIELD



12. A. C. Bearss—Southeast quarter of section 17 (27 north, 4 east), Peru Township	932	285
13. T. Riley—Just north of Peru Driving Park, Peru Township	875	220
14. J. W. Wallick—East half of Godfrey Reserve No. 8, Pipe Creek Township	907	252
15. G. A. Shuman—Northeast quarter Lablonda Reserve, Pipe Creek Township	871	246
16. J. Graham—Northwest quarter of Richardville Reserve No. 5, Washington Township	902	242
17. J. Clifton—Northwest quarter of Richardville Reserve No. 5, Washington Township	904	244
18. Anthony Walker—East half of Richardville Reserve No. 6, Washington Township	983	228
19. R. S. Whittenberger—Northeast quarter Richardville Reserve No. 5, Washington Township	879	204
20. C. C. Ensawiler—North part of Richardville Reserve No. 5, Washington Township	895	220
21. Z. Swank—Northeast quarter of northwest quarter of section 16 (28 north, 4 east), Washington Township	1020	265
22. Emma A. Bearss—Southeast quarter of southwest quarter of section 10 (26 north, 4 east), Washington Township	1006	236
23. S. Thorn—Santa Fe well, Southeast quarter of section 32 (26 north, 5 east), Butler Township	932	215
24. ——— North half of section 32 (26 north, 4 east), Bunker Hill well, Pipe Creek Township	992	161
25. Bennett's Station—On L. E. & W. R. R., 15 miles south of Peru	1009	167
26. ——— Williams—One mile south of Waverly, Cass County	982	225
27. R. R. Depot—Southeast quarter of section 21 (27 north, 3 east), Waverly well No. 1	1000	
28. ——— Davis—Northwest quarter of section 31 (26 north, 3 east), Walton, Cass County	1012	172
29. J. B. Crook—Near Hoover's Crossing, Cass County	1046	346
30. N. Stroud—Northeast quarter of section 6 (27 north, 4 east), Mexico well	998	325
31. ——— North half of section 16 (28 north, 4 east), Denver well	1004	329
32. C. C. Mikesell—Southeast quarter section 7 (26 north, 6 east), Waltz Township, Wabash County	945	220
33. E. J. Williams—One mile south of Keller's Station, Wabash County	879	199
34. Andrews well—Near Wabash Railway	938	209
35. Lutz farm—2½ miles north of Wabash, Wabash Co.	1057	284

Up to January 1st, 1898, the only producing wells in the Peru field outside of the area as defined were two in number. One of these was located just north of Keller's or Rich Valley, a station on the

Wabash Railway nine miles east of Peru, and the other on the west side of the village of Walton, Tipton Township, Cass County. The Rich Valley well is on the farm of W. A. Jackson in the southwest quarter of the northwest quarter of section 13 (27 north, 5 east). A record of this well obtained and kindly furnished by Mr. J. E. Chen-vront, of Peru, is as follows:

Drive pipe	None.
Casing	450 feet.
Trenton struck at.....	883 feet.
Total depth	907 feet.
Surface above sea level.....	675 feet.
Top of Trenton below sea level.....	208 feet.
Initial production, 35 barrels.	

The surface of the Trenton was found at about the same level as in many of the fair producing wells at Peru. In general it may be said that in western Wabash and Miami counties, where the Trenton lies lower than 215 feet below tide, a dry hole or salt-water well will almost invariably result. Whether the Rich Valley strike will develop a pool or an eastward extension of the Peru field only the work of the drill will disclose.

Lying as it does between the western end of the main field and the development at Peru it strengthens the belief that the two are connected. If the connection be not continuous there doubtless exist many small, isolated pools or islands of porous Trenton between the two fields. These islands occupy the sites of lagoons which existed shortly after the time the Trenton was laid down and furnished the conditions favorable for the chemical changes which brought about the porosity of the oil-bearing portions of the Trenton limestone. Therefore, at present the best field for the wild-catter, in the writer's opinion, lies southeast of Rich Valley between that town and Van Buren, Grant County.

The Walton well was sunk on the land of J. Baumgardner, northeast quarter of section 36 (26 north, 2 east), about one-third of a mile west of where a dry hole had been previously drilled.* The Trenton was pierced at 1,011 feet below the surface, and its elevation was therefore about 171 feet below sea level. The drill was sunk 13 feet in Trenton, when the oil rose to within 200 feet of the top of the bore. The well had an initial output of about 35 barrels, and is probably near the outer border of an isolated island of porous rock, or so-called "pool" of petroleum.

*See No. 28 in the table of non-productive bores.

The cost of production in the Peru field is somewhat less than in that of the main Indiana field, especially if the operator owns his own string of tools. The wells are, on an average, 125 feet less in depth. The drift is in general much more shallow and the amount of drive pipe required therefore less. The Niagara limestone is more shelly and broken, and on that account more easily drilled. Between 400 and 425 feet from the surface there is a "break" in the limestone of 20 to 40 feet, which is occupied by a layer of shale. It is customary to case through this break and through eight to fifteen feet of limestone lying below it, which contains a brackish water. The average amount of casing in the Peru field is, therefore, about 450 feet.

The first "pay streak" is found close to the surface of the Trenton, instead of 18 to 30 feet in, as in the main field. In most cases there appears to be but one stratum of porous rock, though in some of the wells where the Trenton is high there are two, the second being about 25 feet in the limestone. In numerous wells there is found below the first pay streak a fine-grained whitish sand, which packs so tightly in the bottom of the bailer that it is difficult to dump. Where two pay streaks are present this sand occupies from two to five feet of the interval between them.

The dolomite or oil-bearing portion of the Trenton is 12 to 20 feet in thickness, darker and much more porous than that in the main field. A piece at hand weighing seven pounds is literally honey-combed with pores plainly visible to the naked eye. It has numerous cavities, the size of a hickory nut or smaller, opening on the surface, which are lined with small rhombohedral crystals of dolomite, so that the cavity resembles, on a small scale, that of the inside of a geode. Intermingled with these crystals are numerous small cubical crystals of pyrites or iron sulphide. These crystals of pyrites are also characteristic of the porous Trenton of the Broad Ripple field, and it is there claimed that only where they occur in numbers is petroleum found in paying quantities.

On account of the porosity of the oil-bearing rock and its proximity to the top of the Trenton but few wells in the Peru field were shot with nitro-glycerine. There was too much danger of shattering the overlying Utica shale and so causing it to fill up the bore into the porous reservoir, or of flooding the well with salt water from the underlying water-bearing portion of the Trenton. A saving of from \$75 to \$150 in cost was effected by omitting the shooting.

The great porosity of the oil-bearing stratum accounts for the richness of the pool, each pore being simply a small reservoir where a stock of petroleum has been stored for thousands of years. With 200

pumps constantly drawing on this stock within an area of a mile and a half square it is no wonder that the output gradually lessens, and unless the pool is larger than it now seems the stock will soon be exhausted. No gas is found with the oil, and it is forced upward in the bore or to the surface by water pressure alone. As the stock of oil lessens the water is slowly rising and in time will fill the pores and take forever the place of the more valuable fluid.

The oil from the vicinity of Peru is darker and more viscid or sticky, owing to its containing a greater percentage of tarry matter or solid bitumens, than that from the main Indiana field. For this reason it is more difficult to separate from the water and more expensive to handle. Being wholly free from gas, it is heavier and has not the life or sparkle of the eastern oil. Up to the present the price paid for the two has been the same, though that at Peru requires a longer steaming to prepare it for the market and a greater percentage of residue is left in the tanks.

The average cost of the first productive well on a lease in the Peru field in 1897 was about as follows:

Rig	\$250.00
Drilling	400.00
Drive pipe	25.00
Casing	125.00
Pumping and tubing.....	130.00
Two tanks	150.00
Receiving tank	40.00
Engine and boiler for pumping.....	450.00
Total	\$1,570.00

The second well cost \$450 less, as the one engine and boiler served to pump both. In many cases, however, the lease consisted of a town lot, where but one well could be put down. Adding to the \$1,570 invested, \$94, the interest at 6 per cent. for one year, and \$480, the wages of a pumper, we have \$2,144, the amount necessary to put down and operate a town-lot well for one year.

The average well on December 1st was making but 18 barrels a day, or 15 barrels aside from the royalty. Of this four barrels were used as fuel, leaving 11 barrels for sale, which, at the prevailing price of oil—41 cents—would be \$4.51 for the income of the operator. If the well should hold up to an eighteen-barrel output for a year, which there is one chance in a thousand of its doing, the operator would receive, at the prevailing price of oil, \$1,646, showing a loss of \$498 on his venture. The chances are that in 1898 the town-lot wells will average less than eight barrels each per day and that but few of them

will ever pay out. Where the leases are in tracts of from 20, to 80 acres and four to ten wells have been put down on them some money will doubtless be made. There is room inside of the productive area for but few companies to operate such leases, and for that reason much more money has been sunk in the field than will ever be gotten from it, unless its area is greatly increased. The following statistics of the field, brought up to January the first, 1898, will aid in showing the truth of the last statement:

STATISTICS OF THE PERU OIL FIELD FOR 1897.*

No. of wells drilled	229
No. of wells producing Jan. 1st 1898.....	178
No. of wells abandoned after producing.....	25
No. of wells, dry holes	26
Daily production Jan. 1st, 1898.....	2,264 barrels.
Average production per well Jan. 1st, 1898.....	12.7 barrels.

PRODUCTION SOLD.

September	10,257 barrels.
October	55,376 barrels.
November	88,725 barrels.
December	67,918 barrels.
Total	222,276 barrels at 41c—\$91,133

APPROXIMATE EXPENDITURES IN THE PERU FIELD.

204 producing wells @ \$1,300.....	\$265,200
25 dry holes @ \$700.....	17,500
Bonuses paid for leases.....	15,000
Capital invested by Buckeye Pipe Line.....	100,000
Salaries paid 50 pumpers for three months.....	7,500
Interest on above amount at 6 per cent. for two months.	4,052
Total amount invested Jan. 1st, 1898.....	\$409,252

THE BROAD RIPPLE OIL FIELD.†

During the year 1897 petroleum in commercial quantities was produced from a number of wells in the vicinity of Broad Ripple, Marion County, five miles northwest of Indianapolis. The developments of the year were such that the field promises much for the future and will doubtless be the scene of active operations during 1898.

*This table includes 11 wells located at Bunker Hill, Denver, Fulton, Mexico, Santa Fe, Rich Valley, Walton and Waverly. The production does not include the amount used for fuel or other purposes in the field.

†Much of the data relative to the Broad Ripple field was furnished by Edward Kirkpatrick, of Indianapolis, an experienced operator, who has made a careful study of the conditions within its present bounds.

The first deep bore put down in this field was sunk for gas in the village of Broad Ripple, southwest quarter of section 36 (17 north, 3 east), in 1888. A record of the strata pierced by that bore is as follows:

Drift	55 feet.
Corniferous limestone	48 feet.
Niagara limestone	257 feet.
Hudson River and Utica shale	504 feet.
Top of Trenton	864 feet.
Total depth	888 feet.
Surface of bore above sea level.....	755 feet.
Top of Trenton below sea level.....	109 feet.

This bore yielded a small amount of gas and a good showing of oil, but neither in sufficient quantities for commercial use, and as gas was the object sought, no attempt was made to develop the petroleum industry.

Three other bores were put down for gas in the vicinity of Broad Ripple about the same time, one on the Jas. Huffman farm, one-half mile west of the town, northwest quarter of southeast quarter of section 35 (17 north, 3 east), which proved dry; a second in Fairview Park, west half of section 11 (16 north, 3 east), two miles southwest of Broad Ripple, and the third on the Boardman farm, three-quarters of a mile northeast of the town, the last two with a fair showing of oil. As the prospectors were at that time also in search of gas but little attention was paid to the presence of petroleum, and drilling was stopped until March, 1896.

At the latter date Mr. Alex. McKnight, an experienced operator from the Pennsylvania field, learned of the presence of oil in the former bores put down near Broad Ripple, and visiting the vicinity, secured leases on about 3,500 acres of land in Washington Township, west and northwest of the town. In company with W. J. Murphy and other citizens of Indianapolis he organized the Keystone Oil Company, and a bore was started on the Wm. H. Sharp farm in the southwest quarter of the northeast quarter of section 34 (17 north, 3 east), one and a half miles a little north of west of Broad Ripple. The elevation of the surface at this bore is about 60 feet above Broad Ripple, or 810 feet above tide. The following is a record of the well as furnished by Mr. Kirkpatrick:

Drive pipe	90 feet.
Casing	425 feet.
Trenton struck at	930 feet.
Total depth	942 feet.
Top of Trenton below tide.....	120 feet.

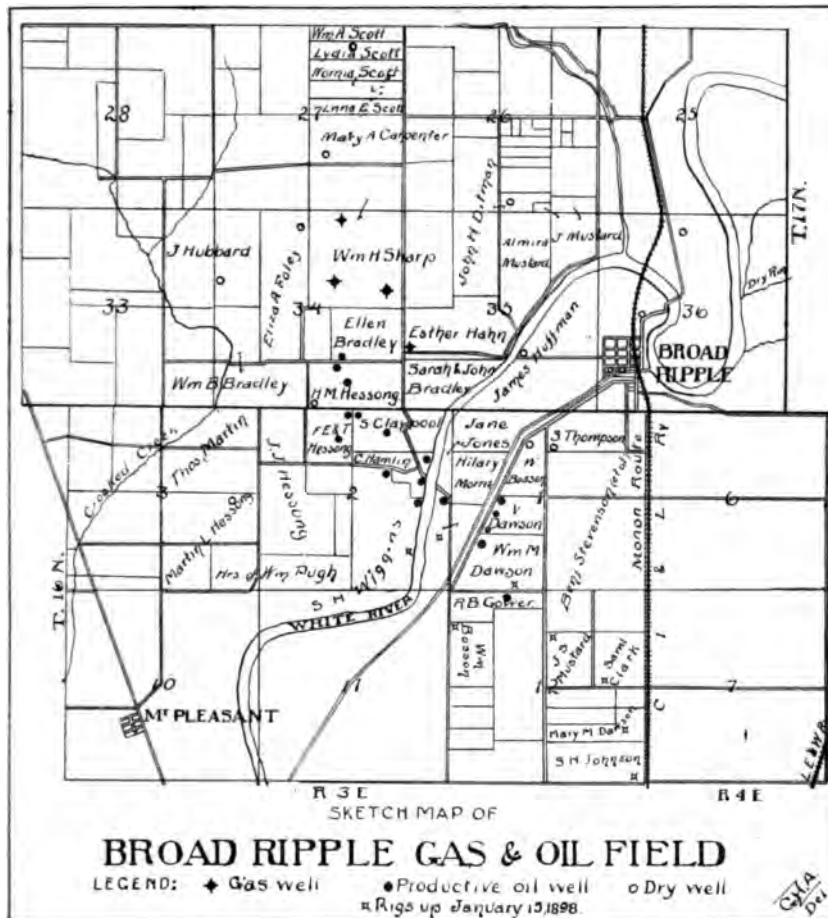
The Trenton was found to be a dark, porous rock and yielded a large amount of gas, the pressure being 315 pounds per square inch and the output estimated at 1,500,000 cubic feet per day. A second bore was put down one mile northwest of Broad Ripple on the Jno. H. Ditman farm, southwest quarter of southeast quarter of section 26 (17 north, 3 east), which proved dry, the Trenton being a close-grained, white, hard rock. Dry holes were also drilled by the same company on the James Hubbard farm, northwest quarter of section 34, and on the Mary A. Carpenter farm, southeast quarter of section 27 (17 north, 3 east), and a second gas well was developed on the W. H. Sharp farm.

In May, 1896, Dr. R. C. Light organized the Broad Ripple Gas Company and secured a lease on the E. A. Foley and H. M. Hessong farms, in section 34, for the purpose of producing natural gas for consumption at Broad Ripple. A bore was sunk on the Foley farm, directly west of the Sharp No. 2 gas well, which developed gas, oil and salt water. The gas was sufficient in quantity to furnish fuel to drill a well on the northwest corner of the Hessong farm. This was finished the latter part of May, 1896, and was the first well producing oil in any quantity in the Broad Ripple field, yielding about 50 barrels the first 24 hours. The owners were, however, seeking gas instead of oil, and though the well was tubed, no pumping attachment was affixed. It continued to flow oil in small quantities, which was barreled on the spot. A second bore in the southwest corner of the Hessong farm resulted in a dry hole, as did also a third on the Scott farm, in the northeast quarter of section 27 (17 north, 3 east). Meanwhile a small oil producer was drilled in by the Keystone Company on the Ellen Bradley farm, just north of the Hessong No. 1. This well was shot once, then drilled deeper and a second shot put in, which in part lodged above the Trenton, and as yet has never been exploded.

The Broad Ripple Company gave up its search for gas and surrendered its leases to the Keystone, after making arrangements with the latter company to furnish gas from the wells on the Sharp farm to consumers at Broad Ripple. The developments of 1896 resulted, therefore, in two small oil wells, three gas wells and six dry holes.

In 1897 no developments were made in the Broad Ripple field until August, when a bore was finished by the White River Company on

the H. M. Hessong farm about 800 feet southeast of the No. 1 well. When the Trenton was pierced at 929 feet oil began to fill the hole and soon ran over the top, and when the well was shot and put to pumping it yielded 125 barrels per day for a week. In a month the production had dropped to 75 barrels, and by January 1, 1898, was down to 15 barrels.



Several companies now entered the field and scoured the surrounding country for leases, which were hard to obtain, as the White River and Keystone companies had most of the land under contract.

The second bore sunk in 1897 was 1,000 feet southeast of Hessong No. 2, on the Claypool farm. It also started at 125 barrels, but trouble occurred by the caving of the Utica shale, the shot having been too

high, and the production soon dropped to 70, and by January 1st, 1898, to 20 barrels. A second well on the same farm, 700 feet southeast of No. 1, was finished on November 23d, and proved the best producer drilled in 1897, flowing 150 barrels per day for ten days, and on January 1st was pumping 50 barrels.

The Ohio Oil Company (an adjunct of the Standard) secured a lease and put down two wells on the F. E. & T. Hessong farm, east half of northwest quarter of section 2 (16 north, 3 east), just west of Claypool's. One of these was drilled 80 feet into the Trenton and shot with 200 quarts of nitro-glycerine. It started at 90 barrels; the other, 700 feet south and 100 west, was a very light well, and is yielding at present but five barrels daily.

At "Crow's Nest," near the bridge across White River, one mile southwest of Broad Ripple and nearly one mile southeast of H. M. Hessong No. 1, two wells were drilled on the Hamlin farm, one of which started at 40 and the other at 100 barrels daily. Forty rods south of the wagon bridge, on the west side of White River, is the No. 2 well on the Wiggins farm. In it Trenton was struck at 850 feet, and the bore filled to within 50 feet of the surface before being shot. After shooting it began to yield 150 barrels daily, and is probably the second best well in the field. The Wiggins No. 1, 1,500 feet northwest on the same farm, is a light producer, yielding about eight barrels on January 1st. A dry hole was sunk by the Ohio Oil Company on the M. L. Hessong farm, in the northeast quarter of the southeast quarter of section 3 (16 north, 3 east), which is one-half mile farther southwest than any other bore in the field. The Trenton was found 15 feet lower than on the E. & T. Hessong farm, and was pierced 207 feet. Between 170 and 190 feet in Trenton the rock became dark and porous, but yielded blue lick water instead of gas or oil.

East of White River are two producing wells, one on the M. Garver farm, close to the east line of section 2, and the other one-third of a mile northeast on the V. Dawson farm. These are the most southeasterly wells in the field, and started at about 40 barrels each.

Two dry holes were drilled in Broad Ripple in November, the Trenton being struck at 850 and pierced to a depth of 40 feet. Bores which produced only a showing of oil were also put down on the Wm. Bosson and S. Thompson farms on the line between Broad Ripple and the V. Dawson well.

The statistics of the Broad Ripple field from March, 1896, to January, 1898, are as follows:

STATISTICS OF THE BROAD RIPPLE OIL FIELD TO JANUARY 1, 1898.

Total number of bores.....	29
Bores producing oil in commercial quantities....	12
Bores producing gas in commercial quantities....	4
Dry holes	13
Wells drilling	4
Total daily production Jan. 1st, 1898.....	230 barrels.
Average production per well, Jan. 1st, 1898.....	19 barrels.

PRODUCTION OF THE BROAD RIPPLE FIELD BY MONTHS IN 1897.*

August	188 barrels.
September	1,886 barrels.
October	1,070 barrels.
November	1,660 barrels.
December	2,892 barrels.
Total	7,696 barrels.

The productive oil wells are found in a strip of territory three-fourths of a mile wide and a mile and a half long, extending in a northwest and southeast direction from the Bradley farm, in the southeast quarter of section 34 (17 north, 3 east) to the V. Dawson farm in the northeast quarter of the southwest quarter of section 1 (16 north, 3 east). The porous oil-bearing stratum lies very near the top of the Trenton, and in the productive wells is found from 10 to 15 feet higher than in the non-productive bores to the northeast and southwest. Salt water in quantity has not been found in any of the wells yet drilled, either productive or dry. The flow of gas in large amounts from some of the wells bored would indicate the presence of a good-sized area of oil-producing territory in the immediate vicinity of the field as developed. There are no indications as yet to prove that the Broad Ripple oil field is connected with the main oil field in Grant and Blackford counties. As already noted, oil is liable to be found in commercial quantities in isolated areas anywhere within 15 to 25 miles of the margins of the main gas field, and will eventually be found over the greater portion of that field. The Broad Ripple field lies on the southwestern slope of the gas field within the distance named. It is most probably an isolated area of porous Trenton rock, formed in the manner previously mentioned†, and its area can only be circumscribed by the future use of the drill. Since wells with a showing of oil have, in the past, been drilled at the Atlas Engine Works, within the limits of Indianapolis; at Brightwood, in section 29 (16 north, 4 east); on the Mary J. Wolf farm, in the northeast quarter

* Not including the amount used for fuel and other purposes in the field.

† See p. 156 of the present volume.

of the southeast quarter of section 21 (16 north, 4 east), and on the Hezekial Smart farm in the northeast quarter of section 6 (16 north, 5 east), two miles northeast of the station of Lawrence, the field may expand into one of large size. At any rate, it at present offers good attractions to the speculative operator, and it is to be hoped that the season of 1898 will bring him a fair degree of success.

* * *

Up to the present, much more money has been put into the Indiana oil field than has been gotten from it. The reason for this lies with the operators themselves, and not with the field. They come in from other States and lease a large amount of territory, which they fail to properly develop. They expect to get rich from the leases and not from the oil which they develop from them. If, within the productive area of each of the fields, a well had been sunk on every eight acres, and those on each lease of 40 to 160 acres connected with one power, and then managed as other successful business interests are managed, the success would have been much greater, and the balance on the ledger of the Indiana field would have been on the opposite side from where it is at present. There is no doubt but that the oil is there, but different methods of development will have to be inaugurated before the field becomes as productive, proportionally, as those of Ohio, Pennsylvania and West Virginia.

ON THE ADVANTAGES OF PRODUCING BEET SUGAR IN NORTHWESTERN INDIANA.

BY E. L. FURNESS, FURNESSVILLE, PORTER COUNTY, INDIANA.

The subject of growing beets, for the purpose of making sugar, to supply the demands of commerce, is attracting much attention in the United States, and it now seems quite probable that the sugar consumed in this country will be produced within it before many years.

A careful study of the subject, makes it appear to be entirely desirable and feasible to do so. It has been proved by actual experience, that it may be done profitably—in itself considered—but that it will also greatly benefit incidentally and directly many other industries.

There are already ten or twelve large sugar factories, located in different parts of the country, east and west, profitably at work, turning out refined sugar, of the best quality, from sugar beets grown in their respective vicinities, and others are now being built. It is said by the Hon. James Wilson, Secretary of Agriculture, "that at least nineteen sugar beet factories will be at work in the United States in the year 1898."

And Hon. Aaron Jones, Worthy Master of the National Grange, in his annual address to the Indiana State Grange, says that he is proud to say, "that at least one, if not two, of these factories will be in Indiana, and that probably they will be in the Kankakee valley of northwestern Indiana."

It seems reasonable to believe, that if a part of the sugar used in this country can be profitably produced in it, that the whole might be, and that it should be; and it is proper that intelligent investigation should be given the subject to discover its requirements, and that whatever may be needed in the way of private effort to bring about this result, should be given it by individuals; but as an essentially wise and economic policy it should also have the encouragement and fostering help of both State and Nation.

More than two million tons of sugar (with 2,240 pounds to the ton) are consumed annually in the United States, and less than one-sixth of it (315,000 tons) is produced at home. One hundred million dollars—more or less—go out regularly year after year to pay for this

sugar. It is bought of nearly every other nation in the world (the countries of Europe, Asia and Africa, South America and the Islands of the Sea—West Indies, East Indies, Phillipine Islands and Hawaii, etc.).

We thus buy what we can, and, with great advantage, should make ourselves. If we were producers, as well as consumers, of this immensely large and indispensable commodity, we should become more independent as a nation, and give needed employment to our own people, thus adding greatly to their comfort and prosperity.

We have here, therefore, not only an important economic question, but an important social one as well.

It is deserving, certainly, of much painstaking study and investigation, from a broad and high plane of patriotic and philanthropic statesmanship, entirely freed from any taint of the prejudice of partisanship.

Sugar beets in large quantity, of proper quality and rich in saccharine, can be profitably grown throughout the State of Indiana, but especially so in the northwestern part of the State. Beets for sugar are said to do best in north temperate latitudes, and in friable soils. There is a large area of sandy, sandy-loam and alluvial soil, in northwestern Indiana, which is particularly favorable for growth of vegetables, as has been demonstrated by actual performance. This soil is easy to cultivate, it is warm and fertile, and there is in this part of the State the proper degree of sunshine, and an especially requisite and favorable amount and time of rainfall, for the growth and ripening of sugar beets, as well as the developing in them of the quantity and purity of saccharine to fit them for profitable sugar making. The price of the land is low, and taxes are nominal. The numerous farmers who occupy this land, in moderate-sized holdings, have the energy, the intelligence and the willingness to make a success of beet raising, and will gladly furnish to factories all that can be used. The facilities for transportation are all that can be needed, and greatly excel those of other parts of the country.

Railroads interlace the land, and shipping stations can be had at any point where freight offers in reasonable quantity. Water carriage can also be surprisingly developed, when the necessity for it is presented.

Northwestern Indiana borders on Lake Michigan, and has several rivers that can be used for freight highways, for taking beets to factories at low cost, and can be used for other freight. Again, the close proximity to Chicago—a great distributing point, and mart of trade, with its immense consumption—is an argument in and of itself of the

favorable location of northwestern Indiana. All the conditions for an economical and prosperous manufacture and marketing of sugar, from sugar beets, seem assured beyond peradventure for this peculiarly favored locality.

All that now seems to be lacking for this consummation is a recognition of the chance, and the determination to do that which should be done, and the accomplishment of making sugar under these favorable circumstances, is so logical and legitimate as to go without saying. Here is the land, waiting as a fair bride; here is the energy of labor and capital, with the opportunity; here is the urgent demand to be supplied, and a great commercial enterprise of incalculable value should legitimately spring into life, to cheer and bless the community.

It is known from experience, that beets rich in sugar, will grow here readily, and satisfactorily, but to place the matter beyond conjecture, scientific tests have been made, for the past ten years, at the Indiana State Agricultural Experiment Station, at Purdue University, Lafayette, by chemical analysis, by the State Chemist, Dr. H. A. Huston, and he reports that his investigations show entirely satisfactory results. He sees no reason to doubt, that from the large per cent. of sugar contained in the beets grown in northwestern Indiana, and the high per cent. of its purity, that they fully meet commercial and manufacturing requirements, for the purpose of making sugar. His tabulated report of analyses of sugar beets grown in 1897, in this section, will soon be made public, and will be found to be assuring as to the richness and good quality of northern Indiana grown beets.

Tests of the sugar value of beets grown in northwestern Indiana are also being made by the Chemist of the United States Agricultural Department at Washington, and will be found to be favorable. There is consequently definite knowledge of the sugar value of beets grown in this part of the State; and the reader is recommended to consult these statistics.

It may not be necessary to draw with minute definiteness the exact border line of what is here spoken of as northwestern Indiana—the line may be considered as quite elastic—and there is no need of naming hard and fast, the many grand counties that are within its boundaries, nor is it essential to figure up precisely its area of square miles, or thousands of fertile acres, well adapted to sugar beet growing, or to enumerate with the exactness of a census its host of intelligent people. It is a vast area, a magnificent territory, a principality, an empire of possibilities, the future home of many people, more millions than now live in the entire State.

The advent of its prosperity depends upon its people coming to the recognition of their opportunities, and in making energetic efforts to realize and to materialize them. Its close proximity, as has already been said, to the large and progressive city of Chicago, makes its domain a source of supply, from a sure vantage ground, of a large portion of that city's great and increasing wants. It has also many large cities within its own borders, and a large and rapidly increasing surplus of cash capital that very unnecessarily and mistakenly too often seeks investment outside, instead of within its own borders. A home investment would be not only safe and profitable, but would immensely increase the value of all home property.

The same kind and degree of energy, and work and faith, that have built Chicago, that raised it from the quagmire, is needed to develop the latent possibilities of northwestern Indiana. The many travelers passing on their way to and from Chicago, through northwestern Indiana, see on the face of things, much that may be unthinkingly, and perhaps freely criticised. They would have seen much to criticise also in the early Chicago.

He who foresees the great transformation that is inevitably to take place in this favored part of Indiana, wonders that it should be so long delayed.

He who has lived to see the evolution of Chicago, is prepared to believe unhesitatingly in the coming development of northwestern Indiana.

The introduction of sugar making, from sugar beets, promises to hasten this development and prosperity—for this region. The men who are actively working for this cause, are benefactors to this part of the State, and to the whole State, and to the American people. The thing to be accomplished is not a light one. It requires work and money, and time, with many discouragements, and all that is implied in awakening dormant energy from its lethargy and unbelief, and to overcome the active hostility of prejudiced opposition, but success is bound to come, slowly probably, but steadily, and then the whole thing will carry itself forcefully forward, and the wonder will be that it was not all done sooner. Sugar making here means improving all the general conditions of society, by introducing a new and successful industry that will put large sums of money into general circulation—it means improving the land, and improved culture of land, planting larger areas, the introduction of a new crop, that will not compete with present crops, but will make added market for them, and one that has the exceptional advantage to its merit, of having the price which is to be paid for it, agreed upon even before it is planted. This

last fact means much to the farmer who has toiled through heat and cold, to raise a crop, and has then found the market over-supplied, and that it could not be sold for cost of production. It means employment of a great number of beet growers, and light, healthful, and profitable employment for women and children, who can thus have the pleasure and benefit of having money of their own earning.

It means the building of factories, and consequent demand for building material (brick, lumber, etc.), and the equipment with machinery—work for mechanics and factory hands—increase of railroad business, which of itself affects all the industries of the country favorably. It means too, a greatly increased demand upon the farmer, for other farm products, to supply the increased population of his neighborhood, a demand too, right at the farmer's own door, which he will find of much more worth to him, than a distant foreign market, and one that will include many articles that could not be shipped away. New houses will be needed, greater sales of merchandise will follow, both of necessities and luxuries, as is always the case with the ability to purchase, consequent upon regular employment, with paying wages. This increase of activity would put money into active circulation and new enterprises would naturally follow, resting upon this basis of prosperity. There would necessarily be a very decided improvement of the highways—live people must move about—and good roads are a necessity to advancing civilization. It would not do to haul a small load of beets ten or twelve miles to factory, when with good roads, two or three times as much might be taken in less time, and with the same team.

All these things, high in color as they may seem, have come to pass at other points, where sugar is being made, from home-grown beets, and with so many favoring conditions, as prevail here in northwestern Indiana, there is no reason to expect anything less, but rather more.

Beets rich in sugar, of high degree of purity, will grow here—that is the foundation fact which can be made strong by a formidable array of statistics. There are here, too, good locations, for factories, with abundant supply of good water, which is needed in large quantity, and there must be ready chance for proper drainage, to take away freely, without discommoding any one, the fouled water used in washing and treating the beets.

There is here also an abundant and cheap supply of fuel, and the same can be said of the lime needed, also in large quantity, in manufacturing. And there can be found the needed number of workmen. With assurance of a full supply of beets, it would seem to be an inviting field for the investment of the requisite capital. One successful

beet-sugar factory established in northwestern Indiana, would demonstrate the truth of the positions herein taken, and would lead to the building of many more. It matters little where this first factory shall be started, it should have the support of the whole district, and of the whole State.

It takes a large sum of money—probably from two hundred to five hundred thousand dollars—to build and operate a modern sugar factory, with its new methods and improved and costly machinery. Prudent and cautious men who have money must naturally be convinced, before investing their money in a beet factory in northwestern Indiana, that all the conditions are correct, and can be depended upon to make the investment a safe and paying one. Confidence is a plant of slow growth, and new ventures, even where the promises are so favorable as in the present case, are apt to be looked upon with doubt. There must be first the sure thing, that the beets, in quantity and quality, will be forthcoming as needed, from 300 to 500 tons, each and every day, for one hundred or more days. This is a large quantity—from 30,000 to 60,000 or more tons; requiring an acreage to produce, in direct use, or to be planted each year, of five or six thousand acres. To keep the land in proper rotation, so that one crop of beets shall not follow too quickly another crop of beets, on the same land, will require a total of twenty or thirty thousand or more acres, within say a radius of ten miles of a factory.

Fifty thousand tons of beets, at four dollars per ton (and five dollars are paid in some localities), would make a health-giving sum of two hundred thousand dollars to be paid out yearly in a comparatively small farming community directly to the beet growers. Multiply the factories to the number of 500, to absorb the one hundred million dollars paid for foreign made sugar brought into the country annually, and there would be a wave of prosperity sweep over the entire land, which would banish all thought of hard times.

The beet tops, and refuse beets, have also value to the grower, for feeding farm animals, and the improved condition in which land is put by beet culture, for better and larger yields to the crops which follow the beets, is an advantage to be considered as additional money value.

The profits of successful beet sugar factories are said to be large, and rightfully they should be, for they cost much money to build and maintain. Insurance, interest and taxes are large items, and the factories run only a small part of the year, perhaps four to five months, and the costly machinery suffers while idle. The larger the capacity

of the plant for using beets, and the longer the time it can be kept running, the cheaper per pound can sugar be made. The fraction of a cent may make a large figure in the profit.

In less than twelve hours after the raw beet enters the factory, the refined sugar from it, may leave in bag or barrel ready for market.

This quick realization on the manufacture is a very big item in favor of the industry of sugar making. There is a large and growing demand for sugar in the United States. It is the largest and best market for it in the world. The consumption of sugar is rapidly increasing in the world; it has more than doubled in the past few years. Sixty-five pounds each, annually, is the average amount used, for every man, woman and child in the United States—not that every person uses directly in the form of sugar, that large amount, but it is used in distilling, brewing, preserving fruits, making jellies and jams, confectionery, chocolate, varnishes, blacking, etc., etc. There are also large quantities of foreign substances, adulterants, added to sugars, such as starch, chalk, white earth (*terra alba*), glucose, etc. The people should protect themselves from such fraud since it is not wise to be imposed upon in any such way. There are immense quantities of glucose, made from Indian corn, and used in the United States as well as exported. It seems to be a legitimate industry, and the time may come suddenly, when the art will be discovered of turning glucose to sucrose, and we shall have sweet sugar made from corn and other grains. There are tons of maple sugar, and maple syrup, and sorghum, and a large quantity of honey is gathered annually.

These sweets are all in eager demand, and enter largely into the food of the people of this country, and are influencing more largely perhaps, than is realized, the character of the nation. It has been said by some physiologists: "Tell me what you eat, and I will tell you what you are."

The Japanese have lived quite exclusively for centuries on rice. They are small in stature, presumably as a result of this diet, and the Japanese Government is now seeking to introduce the general use of wheat among the people, hoping from its bone and muscle making elements to induce a larger stature. The beef-eaters of merry England, are noted for a robustness and an energy, that continually reshapes the maps of the world.

The great consumption, and demand for sweets, requires an immense production, and calls for the employment of large amounts of capital, and of labor, and warrants the investment of money in the industry, so far as demand for the product goes. The question presents itself pointedly then, whether we shall continue to buy our

sugar. It is bought of nearly every other nation in the world (the countries of Europe, Asia and Africa, South America and the Islands of the Sea—West Indies, East Indies, Phillipine Islands and Hawaii, etc.).

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The great consumption, and demand for sweets, requires an immense production, and calls for the employment of large amounts of capital, and of labor, and warrants the investment of money in the industry, so far as demand for the product goes. The question presents itself pointedly then, whether we shall continue to buy our

sugars of other nations, or shall we make them ourselves. If all the conditions are as favorable as assumed in this paper, all that seems necessary is to build the factories, and that is a question of much money. The question of investing money in sugar making in the United States, waits upon, and is dependent upon the will of the people, to be expressed in national legislation, for there must be legislative protection, to this industry, until, at least, it is substantially established, to keep it from disastrous competition of foreign made sugar. This legislation must be without fluctuation, and so reliable in constancy as to command confidence in its stability, as being the settled policy of the nation to effectually encourage and protect home made sugar. This policy would end all doubt as to the ability of the American people to advantageously make their own sugar. This matter of protection to home industries should cease to be a thing of partisan politics, and be recognized as the policy of loyal statesmanship. The experience and practice of other highly civilized, enlightened and prosperous countries, is in direct and positive evidence upon this very question of legislation in favor, and protection of making sugar by their own people. The recent experience of the United States in fostering its iron and steel, and tin, and textile industries is happily directly in point, and is convincing as to its wisdom.

Large sums of money were formerly, continually being sent out of the country to purchase manufactured articles, while the raw material was lying unused in abundance at home, and workmen lying idle, needing work. By simply invoking the aid of the necessary and sensible tariff protection, we now make at home what we formerly bought of other people, and are fully able to supply our own wants in these lines with not only better goods, but at cheaper prices. We also ship such goods profitably abroad. With such eminently and plainly practical good results, so conspicuous that "He who runs may read, and the wayfaring man tho' a fool need not err therein," all the theories that are arrayed against it, seem to be knocked silly, and have no foot, or ground to stand upon.

It is said by making our own sugar, we should prejudice a profitable trade with countries from which we now buy sugar, and this is held as valid argument why we should export wheat to pay for sugar. It is said to take all the wheat, and wheat-flour shipped from the United States to pay for the sugar brought into it. Why is there any advantage in trading, just for the sake of trading? With the yield of one acre of wheat, the American farmer might buy, say 200, or 300 pounds of sugar. That same acre planted with sugar-beets might yield, say 2,000 or 3,000 pounds of sugar, a difference in figures, and

real values, that shows big loss, in the way of friction, or manipulation, or trade, somewhere on the road from wheat to sugar. And it is probably quite true that there is really more sugar in the wheat, than the farmer trades for the sugar, than there is in the sugar he gets for it. It may be worth the while of the American farmer to look sharply into this matter.

If we should make our own sugar, the sugar workmen might consume in this country, all the surplus wheat which is now shipped abroad, making a home market for it, much better than a foreign one, and paying better prices. The farmer has very good reasons for being dissatisfied with present prices of wheat, and would be justified in attempting to create a better market for it, and there would consequently be an added new market for butter, eggs, milk, meat, clothing, and the whole thing of sugar and wheat would be of home, and for home. There is very much that might be said as to the questionable policy of shipping wheat from this country. Whatever will contribute to the healthful growth and independence of this country, whatever will improve the character and condition of our people, is desirable. A study of the promises to these ends, held out, by making at home, all the sugar needed, makes it seem to be the right thing to do. Beet raising requires a more thorough and systematic method of farming, than is usually given to the growing of wheat and corn—and it is more profitable. It is certainly desirable, and quite possible, to improve the manner and method of farming. There is much said enthusiastically about large yields of sugar-beets and of extra high per cent. of sugar value, etc., but 12 tons of beets to the acre, with sugar value of 12 per cent., with proper purity of the juice, say 70 per cent., may be considered as a standard yield, and this will require a good deal of effort to attain, although it may fortunately be quite possible to excel in this region. To make 12 pounds of beets, yield one pound of sugar, will require great skill in manufacture.

Great improvements have been made in the whole art of sugar making—in growing the beets, in the process of extracting and refining, and much more in this direction is yet possible. The horticulturist, the inventor and the chemist have united forces in the problems involved, and the State has protected and encouraged by bounties and privileges, and the battle royal between cane sugar and beet sugar is won in favor of art over crude nature. This paper might be lengthened indefinitely upon the interesting subject of the history of sugar making, and of the disturbing and agitating conditions surrounding it to-day. The subject grows with study, in magnitude and importance, but the paramount question in this subject, even at the risk of repetition, is, Shall the people of this country make their own sugar? There is of course

much chance for the play of sentiment and emotion, in weighing up or adjusting the seeming rights and wrongs which float on the surface of many great and grave questions, but the law of self interest, or apparent self interest, will, and should control in the actions of those who are affected by any given policy. How other lands, and other peoples, may be effected by the people of the United States striking directly for their own advancement and prosperity, is involved in too great and uncertain obscurity to be considered.

There can hardly be a question as to the good policy of having the people of this country fully and profitably employed. It appears so entirely self evident, that no argument of words is needed to support it. It is an unpleasant fact, that there are now, and have been for several years past, many unemployed people—who would gladly work, and their material and moral condition would be greatly benefited by doing so. There has been and still is the general complaint of hard times, and there exists a spirit of unrest and dissatisfaction, which surely constitute a serious menace to the safety of the community. This condition costs immensely in the way of self denials, of suffering and misery, and of stagnation of industry and business, and a retrogression of all material interests. The aggregate cannot be computed in money. It costs much in direct public taxation, and for an unusual support of the needy, and for prosecuting an increased growth of crime.

There is too a great tax upon the charitable, for voluntary contributions to the poor, a tax that in equity should be borne by the State, so that all citizens might bear their proper share of it. In the form of charity it has a very demoralizing effect. It is desirable to have all the people of this country self sustaining and self respecting, even if to furnish requisite employment, enterprises are instituted requiring governmental aid and protection. This means simply, when analyzed, the very proper co-operation of the whole people in the performance of a self protective duty, by enabling all to support themselves by their own labor, without any sacrifice of self respect, and to contribute to the support of the Government. A portion of the community cannot be benefited without the whole community sharing the benefit. Whatever it might seem to cost there would be equivalent value received for it. Whatever is really worth much more than it costs, and is entirely beneficial in its results, is not dear, but is cheap. As George Washington expressed it, "The aggregate happiness of society is, or ought to be, the end of all government."

There seems to be prophecy, shaping into fulfillment, in the general expectancy that sugar making on such a scale as to fully supply our own market will soon be an accomplished fact in the United States of America. It is in the thought and in the purpose of the people.

**A REPORT ON THE NIAGARA LIMESTONE QUARRIES
OF DECATUR, FRANKLIN AND FAYETTE COUN-
TIES, WITH REMARKS ON THE GEOLOGY OF
THE MIDDLE AND UPPER SILURIAN
ROCKS OF THESE AND NEIGH-
BORING (RIPLEY, JENNINGS,
BARTHOLOMEW AND
SHELBY) COUNTIES.**

BY AUGUST F. FOERSTE.

I. GENERAL INTRODUCTION.

This report is a continuation of the one on the Middle and Upper Silurian rocks of Clark, Jefferson, Ripley, Jennings and southern Decatur counties, published in the twenty-first report of the Department of Geology. While the preceding report dealt, however, chiefly with the geological problems involved, especially with the question as to what demarcation of horizons in the Middle and Upper Silurian strata would be most valuable in a study of these rocks from a geological point of view, the present report is concerned chiefly with a study of the principal quarries opened up in these strata, and the purposes for which the stone found in these quarries have been found especially valuable.

And it is desired to state at the very start that the present report does not seek to give an account of every neighborhood quarry. Almost all, perhaps more than 95 per cent., of the stone shipped in the areas here under investigation is quarried in the neighborhood of Osgood, Westport, Harris City, St. Paul, New Point and Laurel. In comparison with these localities the output of all other localities is insignificant.

This does not signify that the limestone at other localities is not as valuable as that found at the localities just mentioned. Some quarries now scarcely worked or altogether abandoned are known to have

formerly produced great quantities of valuable stone. But various circumstances have contributed to make the working of these quarries no longer as profitable as was formerly the case.

In many cases the stone could be worked with profit while the workings were confined to the outer faces of a cliff or hillside. But as soon as the quarrying operations were carried deeper into the recesses of the hill the amount of clay and gravel which had to be removed in order to reach the valuable stone increased in quantity and materially reduced the profits of the investment. Moreover, on entering the hillside new strata would be exposed to view which were not encountered while the quarrying was confined to the lower parts of the hill or cliff. These strata, which came above the valuable building rock first exposed were often of no value themselves, and their removal entailed much expense. These quarries were usually abandoned as soon as the worthless rock exceeded more than five or six feet in thickness.

For a time most of the quarrying which was done in the areas here considered was carried on in spite of great inconveniences as regards shipping facilities. The stone was quarried at a distance from the railroad and was hauled by wagons over bad roads to the railway station.

As soon as the most enterprising companies secured switches connecting their quarries with the railroad the additional expense of double loading, once on the wagons and a second time on the cars, was avoided. The quarries not having these advantages were no longer able to compete with these companies unless they had unusual natural advantages. The chief quarries in the neighborhood of Osgood, Westport, Harris City, St. Paul and New Point all have switches running from the quarries to the railroad stations. Laurel is the only region of any consequence which does not have such connections, and its output would be greatly increased, to the advantage both of the quarries and of the railroad companies, if switch connections were established.

The fact is that Laurel possesses certain natural advantages which have enabled the quarries there to compete with the quarries elsewhere, even without the assistance of switches. These natural advantages consist in the fact that the valuable stone at Laurel is well exposed at many points so near the tops of the hills that considerable quarrying may be done without reaching sufficient poor overlying stone to materially interfere with the profits of the quarry. Moreover, most of the layers are so thin that while the Laurel stone is of no great value as a building stone, yet it is without a rival in the ease with which it is possible to secure there great quantities of stone of just

the right thickness for curbing, gutter stone and flagging stones. This natural advantage would be much emphasized if the Laurel district were placed on a par with other regions as to its shipping facilities.

In addition to the quarries just mentioned there are many neighborhood quarries which furnish just enough stone to supply the demands of the neighboring farmers and villages for cellar and foundation stone. Work is done at these quarries only spasmodically and their total output is small. In the course of time their history will probably be different. Some new line of railroad not foreseen will bring some of these quarries into prominence. But at present they have no great value. Many of these smaller quarries are however mentioned in the body of the report when they show some features of interest in studying the general distribution of the quarry rock in this part of the State.

VALUABLE COURSES OF STONE.

In last year's report the Upper Silurian rocks were divided into the following horizons, mentioning the upper horizons first:

	{	Louisville limestone.
	.	Waldron shale.
<i>Niagara.</i>	{	Laurel limestone.
		Osgood beds, including limestone and
		clayey shales.
<i>Clinton.</i>		Clinton limestone.

In the area here under investigation only one horizon furnishes stone which is of any value commercially when quarried on a large scale. This is the Laurel horizon. At the very top of the Osgood beds there is often a single layer of limestone which can be used for the same purposes as the Laurel limestone, but often it is of inferior quality, and in any event it forms only a very small part of the rock actually quarried.

The layer at the top of the Osgood beds is about 14 inches thick where it is most worked. Immediately below this layer of limestone is a shaly clay layer, usually about 15 to 24 inches thick, which is locally known as the soapstone bed and which marks the base of all the quarrying operations in this part of the State.

The Laurel limestone, which is the real source of supply for all the good limestone of this section, has a total thickness of about 45 feet. This does not mean a total thickness of 45 feet of serviceable stone. At various levels the Laurel limestone beds contain cherty nodules and even almost continuous cherty layers, which more or less vitiate

the usefulness of the stone. Moreover, different layers of the limestone free from chert vary considerably in their chemical constituents, some layers containing more argillaceous material than others. These more argillaceous layers are less white in color; they are softer and show the effects of wear sooner; they are more readily disintegrated by the ordinary processes of weathering, of heat and cold, than the purer layers of limestone, and are therefore of much less value where continually subjected to the influences of weathering.

The very same quarry, therefore, shows layers of the very best limestone, and also layers which are vitiated by the presence of chert or which are too soft and which disintegrate too readily for many kinds of work.

It is very easily possible to discriminate between the different grades of stone, even without the assistance of chemical analyses. The better layers of limestone always form the projecting ledges on the faces of cliffs in the neighborhood of the quarries. The softer, more readily disintegrated layers, however, form the recesses between the better layers. On the face of the cliff the softer layers have often worn back several feet; they have often disintegrated enough to change from apparently a fair quality of limestone to a series of cracked and shaly limestones, which crumble away readily under the blow of the hammer.

In quarries which have no cliff exposure the poorer layers are discovered as soon as the quarries are opened, because disintegration takes place not only on the sides of cliffs exposed to the air, but also under the surface of the ground where plentifully supplied with water. Therefore, as soon as the stone is uncovered in the processes of quarrying the poorer qualities of stone proclaim their character by being reduced to a mass of friable limestone material near their edges and just beneath their covering of clay or soil.

The frequency with which the different layers are traversed by cracks is also indicative of their wearing qualities when exposed to the influences of weathering and of rough usage under foot. The good layers will show relatively fewer cracks, while the poorer layers will be traversed by frequent and often quite adjacent cracks, the stone being often reduced to a sort of limestone shale.

Any quarry which has been opened for a number of years is likely to have a considerable dump pile where the irregular pieces of limestone are thrown. Usually quite a number of pieces of limestone accumulate which have by no means been discarded, but which have not yet been sold. In any large quarry there is practically no layer of limestone which is not represented by some slab, lying in some part of the

yard, and which has been quarried during some preceding season. Any stone which will not readily withstand the influences of weathering when exposed to the changes of weather in winter is not likely to resist changes of weather readily when exposed to changes of temperature and to differences of moisture when inserted in the walls of buildings, and still less when used for sidewalks, curbings, gutter stones or for exposed bridge work.

The fact is that quarrymen are well acquainted with the characteristics of the different layers exposed in their own quarries. An experienced quarryman will identify at sight any one of the many layers of limestone lying promiscuously in the quarry yard and give a very good estimate of its comparative value for any specified purpose. In the presence of a person who is not a possible purchaser he will express himself with great freedom. In the presence of a buyer, however, all the layers seem to grow in value.

When a large order of stone comes in, the inferior layers of stone are often placed in requisition to fill in the order in the stipulated time. It is this dishonesty on the part of the quarry owners which has done much to bring the limestone into bad repute when brought into competition with good stone from other localities. Usually the quarrymen deny all charges of dishonorable dealing in furnishing poorer stone, when the samples originally shown were of better quality, by saying that the buyers who were securing the stone were offering such pitiable prices that they had no right to expect a better quality of stone for the money which they were paying. Or, they argue that it was necessary to use the inferior quality of stone in order to fill the large order of stone which they had received within the stipulated time, which is often no doubt true; but this does not assist in establishing a good reputation for the stone from their quarry.

Several quarrymen whom I visited frankly declined to give me any information concerning their quarries, on the ground that it would not assist them in any way financially to have the true character of the various layers in their quarry known. In several cases they told me of cases in which they had filled orders partially by the use of inferior stone, and also of cases in which stone which they had supplied had proven unsatisfactory for similar reasons.

There is not the slightest doubt that sharp practices of this kind, no matter what the cause or motive, must place the quarry supplying the order in disrepute.

The presence of chert nodules does not necessarily interfere with the value of limestone layers if they occur only in small quantities and are not likely to split the rock when exposed to the influences of

weathering. The unequal expansion of chert and of the surrounding limestone will sometimes result in the parting of the rock along the plane occupied by the chert nodules.

The chief damage of the moderate presence of chert nodules in the limestone is to the cutting tools. Provided the stone is to be used for purposes which do not require further cutting after the stone has left the quarry, the damage to the cutting tools is confined to the operations at the quarry, and the expenses of broken tools is added to the other expenses of quarrying. To the purchaser the presence of chert offers, however, no inconvenience.

When, however, the stone is to be used for purposes which require further cutting after the stone has reached the hands of the purchaser the presence of chert nodules is often a serious additional and perhaps totally unexpected expense. Cherty layers of limestone, in other words, are not very suitable for cut stone.

COMPETITION WITH CEMENT.

The Laurel limestone occurs in such thin layers, and is so readily quarried into slabs of quite considerable area, that it has always been regarded as the natural stone for purposes of constructing sidewalks, street and gutter crossings, curb stones and gutter stones. Of late years it has, however, had a serious competitor in cement, the use of which has increased to a remarkable extent. While formerly the sidewalks of almost all the towns in western Ohio and in Indiana were chiefly constructed of the Laurel limestone or its Ohio equivalent, at present the use of cement has almost entirely superseded that of the limestone. Many reasons have contributed to this change. The cement is easily shipped from place to place in barrels, which are readily loaded and unloaded without the assistance of cranes or derricks. A much smaller weight of material requires shipping when cement is used. The sand and grouting used in connection with cement is usually readily obtained at the locality where the cement is to be used at very moderate expense. This is a great saving in the item of shipping expenses. Moreover, when a poor quality of limestone is shipped, owing to reasons mentioned in preceding paragraphs, the cement sidewalks, if well constructed, are found to be more even and more durable than the limestone slabs.

For quite a number of years after cement had become a serious competitor to the Laurel limestone for walks the limestone remained by far the most used material in western Ohio and in Indiana for curb and gutter stones. During the last few years cement has, however,

begun to be a serious competitor even for these uses. This is especially true in the residence parts of cities, where heavy hauling is not likely to be done, and where, therefore, the wheels of vehicles are not likely to cause serious damage.

In some of the larger towns it is now possible to find miles of curbing and gutter where cement has been used. The curbing and gutter is usually constructed at the same time. The grouting is put down solidly and heavily, there is no break between the curb and the gutter and the entire length of curbing and gutter is continuous around each square, cement not being used where the gutter crosses the street.

COMPETITION WITH IRON.

Formerly gutter crossings were largely constructed of limestone slabs. At present, and indeed for many years, cast-iron crossings have been used to a large extent. They are neater; they are much thinner, and therefore give a greater amount of space for the passage of water, when compared with slabs whose upper surfaces had no greater elevation above the bottom of the gutter. For similar reasons iron plates have taken the place of the limestone slabs, which were formerly more commonly used as coverings for gutters where these crossed over intersecting streets.

COMPETITION WITH IRON AND CEMENT.

One of the most recent fields in which limestone has been brought into competition with other materials has been in the construction of bridge piers. The heaviest slabs of limestone were formerly much in use, and they are still employed largely. Recently, however, piers have been constructed of large tubes of iron, which were subsequently filled with cement. This forms a structure as firm as solid stone.

Even in the case of bridge abutments in some cases tubes of iron filled with cement have furnished the main support of the bridge at either end. Behind these piers large slabs of limestone have been placed, and behind these slabs rough broken stone of all sorts has been packed, held together by the abundant use of cement. There is no doubt that in many cases this forms a perfectly satisfactory bridge backing.

In all of the preceding paragraphs it should be remembered that the term, Laurel limestone, does not mean the limestone found at Laurel as distinguished from the limestone in other localities in the field here under investigation. The same series of limestones which are found at Laurel are also found at Osgood, Westport, Harris City, St. Paul, New Point and other localities.

It is convenient to have some name which can be used to indicate the general class of white limestones which is found at all of the localities just named, and it is quite common to name a series of rocks after the name of some locality where they are very readily found. The choice of the locality, Laurel, as the region which should furnish the name for the general series of white limestones found in eastern Indiana was purely a matter of accident, and the expression, Laurel limestone, is only a general expression for all the limestones here specially considered.

FORM IN WHICH THE LAUREL LIMESTONE USUALLY OCCURS.

The Laurel limestone usually occurs in horizontal slabs which vary considerably in thickness, but the variation in thickness lies between rather narrow limits. In the region of Longwood, slabs an inch and a half, two inches and two inches and a half are very frequent, but these quarries are no longer run on a large scale. In the neighborhood of Laurel the slabs are usually four, five and six inches thick, but layers seven, eight and nine inches thick occur with sufficient frequency to enable the quarrymen to furnish stone also for purposes requiring heavier stone. Some thinner layers, two and three inches thick, also occur, but the characteristic stone at Laurel varies between four and six inches, with only occasional layers of greater or smaller thickness. At New Point the slabs vary chiefly between eight and ten inches, although some of the layers hang together sufficiently well to be quarried into 12 and 15-inch slabs. By a process of splitting or capping some of the layers can be separated into four-inch slabs. The quarries at St. Paul, Harris City, Westport and Osgood all show layers four inches thick. Layers five and six inches thick also occur. But seven, eight, nine and ten-inch layers are the characteristic layers at these quarries. Moreover, the different layers can be quarried out together more commonly than farther northeastward, so that slabs 12, 15, 18 and even 20 inches thick may be obtained. Occasionally slabs 23, 24 and 25 inches thick have been secured from certain layers in some of the quarries. It should be remembered, however, in the case of these much thicker slabs, that they in reality consist of a number of slabs that can be easily split or capped, and that they can not readily be subjected to great pressures parallel to the bedding. When used, however, in position where the pressure is vertical to the bedding these large slabs have proved very serviceable, requiring less handling and not demanding the use of as much cement or mortar in the construction of piers for bridges and other heavy work.

USES TO WHICH THE LAUREL LIMESTONE IS PUT.

In the construction of buildings the thinner layers are used for window sills and window caps. The thicker layers make very good door sills and range stone. By range stone is meant the layer of dressed stone which is placed just beneath the brick of a brick building and which serves as a sort of protection to the underlying ordinary cellar stone. The range stone usually projects a short distance beyond the cellar stone and thus sheds the rain which during a storm runs down the walls of a building.

Medium-sized stone is used for ashlar. Ashlar is the name applied to the flat stone slabs which are placed in an upright position on the outer surface of the cellar stone of the better class of buildings. These slabs offer an additional protection against the rain to the cellar stone. It is customary to dress the exposed face of the ashlar, very much improving the appearance of this part of the building.

Heavy slabs are used for steps and large slabs are used for the broad slab which usually forms the top of a series of steps, furnishing a landing at the top of the steps and immediately in front of the doorway.

Fairly heavy slabs of considerable length and breadth are also in great demand for porticos and porches. For the foundation of ordinary houses the fragments rejected for other purposes on account of their insufficient size are used. This cellar-stone material is usually known to quarrymen as rubble.

Below the foundations of very heavy buildings very large and thick stone are usually placed to serve as a strong and broad foundation for the superstructure. These heavy stone are known as footings.

In the construction of jails, one or two slabs of limestone are sometimes used to form each side of the cell. These slabs must, of course, be of considerable size. Three or five of these slabs will completely surround the cell by walls in which it will be impossible for the prisoner to make any insertions, and from which he will be unable to make any removals without having the same readily discovered by the jail authorities.

Reference has already been made to the use of limestone slabs for sidewalks, street crossings, gutter crossings, curbing and gutter stone. Usually the thinner layers of stone are found to be of sufficient thickness for these purposes.

In the case of bridges, the very heaviest stones are used for pier footings, or the very heavy stones placed at the base of piers. Similar

heavy stones will be used for the construction of the piers themselves. Large, heavy, thick slabs are used as a capping to the piers, and as a support to the ends of the iron superstructure.

The very heaviest layers of limestone are used for bridge abutments. The heavy stone is usually placed in that part of the abutment which is exposed to the fury of the water during high freshets. Behind this outer surface of very heavy stone the backing of the abutment is placed. This consists usually of riprap and gudgeon, piled in closely and held together by cement. By gudgeon is meant the yellow, soft stone which is usually found forming the upper layers of any quarry, before the regular good quarry stone is reached. In the quarries in the area here under consideration the gudgeon consists usually of thin layers, two to four inches thick, which are likely to be more or less filled with chert or to be at least associated with chert.

The large four-inch slabs which are now occasionally placed behind the iron post or pillars of bridges on the abutment side, and behind which a backing of rubbish and cement is placed, have already been mentioned.

Heavy limestone is used for the bases of monuments, and thin layers are used as grave covers, directly over the caskets.

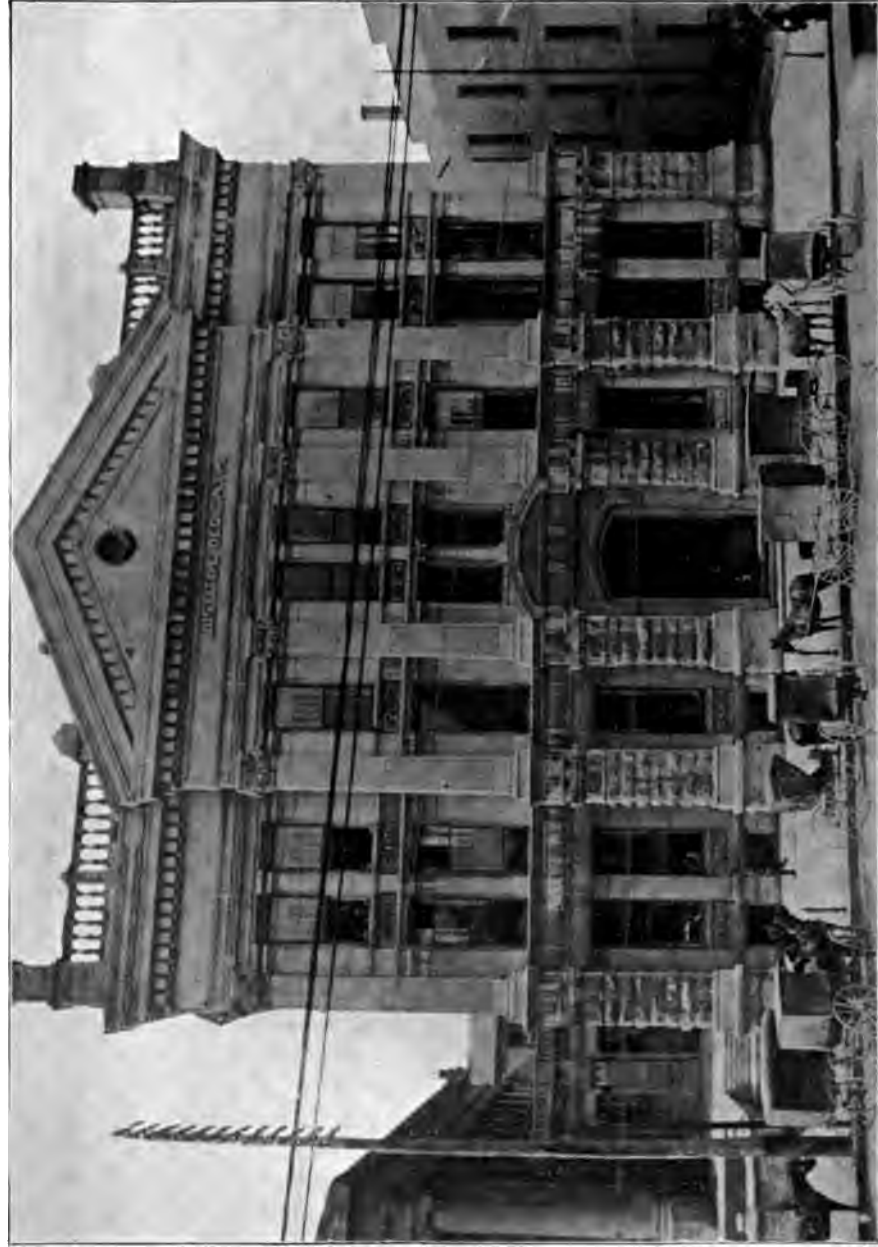
The heaviest layers are used in the construction of milk troughs and drinking troughs.

WHY THE LAUREL LIMESTONE IS ESPECIALLY USEFUL FOR THESE PURPOSES.

The Laurel limestone occurs in the quarry in the form of slabs of nearly uniform thickness in the same layer. Different layers, however, vary considerably in thickness, as has already been described. The upper and lower surfaces of these slabs are so nearly even that where no dressed work is required the stone is already sufficiently smooth on these two faces to be at once used. Even where it is desired to use dressed work the flatness of the upper and lower surfaces makes it necessary to do but little extra cutting there. Stone for almost any purpose can be therefore secured by selecting those layers in the vertical section in the quarry which have the proper thickness, and, after the stone has been quarried, the two faces in question are already trimmed by nature, altogether or nearly ready for use.

More than this, the quarryman may break out the stone slabs in such width that the stone will require scarcely any trimming around the margins of the slab, when being prepared for use.

It is readily seen that any stone which occurs in layers of all sizes,



COURT HOUSE AT DAYTON, OHIO.
(Constructed of white Niagara limestone.)

as regards thickness, and which is already trimmed by nature on the two largest surfaces, can be quarried much more cheaply than a stone which is more massive, and which must be first split in order to reach these dimensions. For this reason the Laurel limestone will always be the pre-eminent stone for use in all cases in which it is desirable to use the stone in the form of slabs of greater or less dimensions. It may be crowded out in part by the cheaper cement, but in any case where it is desirable to use stone at all, the Laurel limestone will be cheaper to quarry, and it will be cheaper to work.

PURPOSES FOR WHICH THE LAUREL LIMESTONE IS NOT SUITABLE.

The Laurel limestone is a hard rock. It is not readily carved. This does not mean that it can not be carved at all. I have seen pillars of stone, equivalent to the Laurel limestone, which have been carved in the most delicate fashion, but it has been hard work. Of course the stone, when once carved, should retain the carved surface for a long time, but carving such a hard stone is too expensive, and for all purposes requiring carving the Laurel limestone will be always superseded by the Bedford limestone in Indiana, and by the Berea sandstone in Ohio.

THE USE OF LAUREL LIMESTONE FOR FINE ARCHITECTURAL CONSTRUCTIONS.

The value of the Laurel limestone for strictly architectural purposes has never been fully appreciated. I do not know of any striking use of the limestone in an architectural way in the entire State of Indiana. And yet it is a stone admitting of excellent architectural effects, when properly handled in conjunction with other materials. In order to justly appreciate the value of the Laurel limestone it is necessary to go to Dayton, Ohio, where the stone equivalent to the Laurel limestone is known under the name, the Dayton limestone.

Many of the most striking buildings recently erected in the city show the value of this stone when used in conjunction with other materials. This is especially true of some of the buildings in the resident portion of the city.

The Laurel limestone is a very white rock. This color is usually in strong contrast with that of any other rock. When used with taste, the white limestone does much to enliven the appearance of a building otherwise dull and gloomy in appearance. The white limestone usually offers good contrasts with the red color of bricks, and

is especially striking when used in combination with pressed bricks. It gives a very chaste appearance to a building in which the upper story is composed chiefly of light painted wood, the white limestone forming the lower part of the building.

Of course the limestone must be free from iron pyrites, or else the weathering of the pyrites will soon streak the walls of the building with the most unsightly streaks of brown. But this can readily be avoided. There are numerous quarries in the region here described in which certain layers are entirely free from pyrites. Quarrymen furnishing stone containing iron pyrites, when the contract has been for stone free from pyrites, and when they have been informed by the architects that the stone in question is to be used to produce special architectural effects, should have their names published as those of men to be avoided by the entire fraternity of architects; and those who furnish only good stone should be paid a price worthy of their labor and care.

METHODS OF QUARRYING IN USE.

The methods of quarrying in use in many of the quarries in the Laurel limestone are often very primitive. After the quarry has once been opened, holes are drilled by means of hand-drills a certain distance behind the front edge of the uppermost layer. Wedges are inserted in the holes thus formed, and a slab of a definite width is thus removed. The drill holes are placed in a row parallel to the front edge of the layer, closer together or farther apart, as experience directs the quarryman, the distance being determined by the hardness of the layer being worked.

The original length of the slab is usually determined by the presence of seams which traverse the limestone in approximately parallel directions. After the blocks of stone have been once loosened they are divided into such lengths as are considered desirable.

Some of the quarries at Osgood, Westport, Harris City, St. Paul and New Point have, however, introduced the use of steam drills, and of steam channelers. The channelers are used to cut deep grooves into the stone parallel to the face of the quarry, and also to cut similar grooves at the extreme right and left of the area quarried. The steam drills are then employed to divide the large blocks of stone thus blocked out into smaller pieces.

The methods employed are essentially the same as used in the workings of other quarries, and have been very well described in the report on the Bedford stone given in the Twenty-first Report of the Indiana Geological Survey.



RESIDENCE CONSTRUCTED OF WHITE NIAGARA LIMESTONE.
(Thick and thin courses.)

II. A GENERAL ACCOUNT OF THE UPPER SILURIAN ROCKS IN THE COUNTIES CONSIDERED IN THIS REPORT.

In descending order the following Upper Silurian formations are found in eastern Indiana:

<i>Niagara Formation.</i>	{	Louisville limestone.
		Waldron clay.
		Laurel limestone.
		Osgood limestone and clay.
<i>Clinton Formation.</i>	}	Clinton limestone.

A brief account of the various formations is given in the following lines:

THE CLINTON LIMESTONE.

The Clinton limestone of the more southern counties is quite fully described in the preceding report. North of New Point it varies in thickness from 5-6 feet, at St. Maurice and at Larkin Walter's quarry, to seven feet near the Cave Hollow Falls in Franklin County. At New Point the Clinton is less than 3 feet thick. A mile and a half directly east of Buena Vista and a short distance southward the Clinton is only 5 feet thick, and a mile west of this town it seems to be reduced to three and a half feet.

At Senior's quarry, south of Bull Town, the Clinton is 3 feet thick; at Bull Town it shows pebbles. Farther northward the following thicknesses are shown: At Derbyshire Falls, $7\frac{1}{2}$ feet; three-quarters of a mile eastward, $5\frac{1}{4}$ feet; at Chris Mead's quarry, $6\frac{1}{2}$ feet; a short distance below Harrison Crowell's quarry, not quite 3 feet; an eighth of a mile below, or eastward, $3\frac{1}{2}$ feet; at Harry Manley's quarry, 3 2-3 feet; at D. L. Sechrist's quarry, 3 feet; about a quarter of a mile eastward, $3\frac{1}{2}$ feet; at D. L. Sechrist's quarry, north of Little Sain's Creek, a little over 2 feet; near John Deis's house it varies from nearly 2 to 2 2-3 feet; near John Bower's house it varies from 3 to 4 1-3 feet; at Daly Adams's, 4 1-3 feet; at Reiboldt's cave, 7 feet; at the Dry Branch quarry, only 1 foot.

In Fayette County, at church half a mile north of the county line, on Big Sain's Creek, it is 3 feet; at Huston's quarry, $4\frac{1}{2}$ feet; at Ball's quarry, near Longwood, 4 feet.

As compared with the thickness of the Clinton at the nearest localities in Ohio the Clinton undoubtedly thins out westward.

The Clinton has no value as a building rock. It is considerably used in southern Ripley County as road material in the form of crushed stone. Where other material can not be obtained it is undoubtedly much better than sand or clayey gravel.

It has been suggested that the crushed Clinton might be used for grouting in case the cement works at Laurel were established.

THE OSGOOD BEDS.

A short distance east of the Alfred Ashman quarry, west of Osgood, the Osgood beds are well exposed on the north side of the stream, which heads in the quarry. About a foot at the base of the quarry is not exposed. Above this are 44 inches of clayey material, which farther northwest very much resembles the Madison rock, and which has sometimes been confused with the latter. Above this are 40 inches of clayey and rubbly limestone, such as is very characteristic of the upper half of the Osgood beds in this part of the State. Overlying this are several inches of clay; this clay layer is quite well known among quarrymen under the name of the soapstone bed. The soapstone bed usually forms the base of the quarries opened in the Laurel limestones. The reason for this lies in the fact that the top of the Osgood beds is usually formed by a limestone layer, which is of such good quality that it can be quarried with profit. Not infrequently this upper Osgood limestone layer proves treacherous when used for outside work, where the stone is required to withstand weathering, but for most inside work it is usually sufficiently lasting.

The soapstone layer forms the base of all the quarries worked along Sand Creek. The first layer above the soapstone rarely stands weathering, but is quarried for inside purposes. The total section of the Osgood beds is well shown at the Westport limestone quarry, where the basal layer is seen to consist of about 14 inches of fairly hard limestone. Overlying this are 46 inches of Madison-like clayey rock; then 66 inches of poor limestone; and finally, 14 inches of the so-called soapstone overlaid by the 14-inch limestone bed, which completes the Osgood section, and which is the lowest rock here quarried.

The lower Osgood beds were once quarried at the McGee quarry, but on account of their inferior quality their use was soon abandoned. A part of the Osgood section is well exposed down the creek from the Harris City quarry. Enough is seen to show that the section is essentially the same as that exposed at the Westport Limestone Company quarry.

The Osgood limestone was formerly quarried at the J. L. Scanlan quarry, near St. Paul, but this part of the quarry has been abandoned and the quarry hole has been filled up with water. The Osgood limestone is still worked in the more northern H. C. Adams quarry. The section does not closely resemble the Osgood sections of the Sand Creek region, but it presents features so closely similar to those of the New Point as to admit of their ready recognition. This similarity consists especially in the presence in the upper part of the Osgood section of limestone, which is so irregularly intercalated with clayey masses that the section appears more like a clayey rock, with irregular streaks and lenses of crinoidal limestone material. This stone will not withstand weathering at all. Its use has been abandoned in all parts of the State, except at the Scanlan quarry and at the New Point quarry. The usual thickness of this inferior clayey limestone is about 48 inches. Underlying the same should be about 5 feet of clayey shale, representing the basal portion of the Osgood section. The soapstone layer above the clayey limestone can not be recognized at this locality. The so-called soapstone of this locality belongs to a lower horizon.

The Osgood beds are well exposed at New Point. Lithologically they present the same streaky argillaceous layers between impure limestone layers, which have been already described as occurring at the St. Paul quarries. But in the case of the St. Paul quarries the horizon of the Osgood beds is not as satisfactorily determined as is the case at New Point, because at St. Paul the underlying Clinton is not exposed, and without the Clinton as a guide, the Osgood beds can not always be readily recognized when showing abnormal lithological features. The Osgood beds at New Point are about 11 feet thick. At locality 206, northeast of Larkin Walter's quarry, the Osgood beds are about 11 feet thick. The so-called soapstone layer, near the top of the formation, is here about 2 feet thick. At the Senior quarry, south of Bull Town, the Osgood beds are about 9 feet thick; the soapstone layer near the top is about $1\frac{1}{2}$ feet thick. At the Derbyshire Falls the Osgood beds are about $9\frac{1}{2}$ feet thick, including the limestone layer above the soapstone ledge. At D. L. Sechrist's lower quarry the Osgood beds are about 9 feet thick; the soapstone layer near the top of the beds is 20 inches thick. At Harrison Crowell's quarry the Osgood beds are about $13\frac{1}{2}$ feet thick; the soapstone layer is seen. At Harry Manley's quarry the Osgood beds are 8 1-3 feet thick; the soapstone layer near the top is about 1 foot thick. At A. W. Cloud's quarry the Osgood beds are about 8 feet thick; the soapstone bed was not measured. At D. L. Sechrist's

quarry, north of Little Sain's Creek, the Osgood beds are 7 feet thick; the soapstone layer is 20 inches thick. At least 6 feet of rock assignable to the Osgood beds are seen at the Longwood quarries, but the total thickness is not known; nor is it certain whether the soapstone layer, which farther south is always found near the top of the Osgood beds, is here present.

The general characteristics of the Osgood beds as seen near Osgood consist of a series of clayey rocks, averaging about 10 feet in total thickness; overlying the clayey rocks is found a shaly soft clay, varying from 1 to 2 feet in thickness; above the clay or so-called soapstone layer are several layers of limestone, carrying the characteristic Osgood fauna. Aside from the abundance of fossils at this horizon the limestones at the top of the Osgood beds are often not to be distinguished from the limestone layers of the overlying Laurel beds. On going northward and northwestward from Laurel it becomes more and more difficult to distinguish the upper Osgood limestone beds from the lowest Laurel limestone beds. As a matter of fact, the shaley clay, or so-called soapstone layer, usually about a foot thick, which is found near the top of the Osgood beds, is usually the only indication that a horizon just beneath the top of the Osgood beds has been reached. In the entire Laurel region in western Franklin county, therefore, the soapstone is the only real indication that the top of the Osgood beds is near at hand. In the various sections of the quarried rocks in Franklin County the lowest layer of limestone just above the soapstone layer has been added to the Osgood section in order to make the Osgood section of these regions appear more in accord with those of more southern regions. The fact is that it is impossible to determine whether one, two or even three layers at the base of the good quarry rock should be added to the Osgood section in this region, since the Osgood beds cease to be richly fossiliferous northward, and the lithological distinctions are insufficient.

That portion of the Osgood beds below the soapstone is at present quarried at New Point.

I consider the stone, however, of very inferior value; I do not believe that it will stand weathering; and do not believe that it should be put upon the market. The fact that it is usually employed where it is not readily seen after it is embodied in the masonry does not recommend it for extensive use. Where exposed to the atmosphere it always weathers badly, and it is not to be considered good practice to place such stuff on the market.

The Osgood beds below the soapstone layer were formerly also worked in some of the quarries near Laurel. They are there known as the lower quarry rock. The rock was a miserable failure, and it

is quite amusing to note the explanations which are offered to account for its ready disintegration. For the stone soon becomes so disintegrated that it readily crumbles under the blow of the hammer. One season's exposure to frost and rain in the quarry yard is usually sufficient to spoil the sale of the rock. It seems that quite a number of years ago extensive operations were begun in this lower quarry rock. A part of these operations extended into the winter. Before the spring had arrived the stone was already useless. Indeed in some cases the stone could not be brought down to the railroad station within a short time after quarrying operations had begun if several strong frosts had intervened. Of course, the damage had been caused by the frosts, but the quarrymen believed that there was nothing the matter with the stone itself and that if it were quarried in summer weather it would harden and form a most serviceable stone. It is almost needless to say that this hope will never be realized.

THE LAUREL BEDS.

The line of railway running between Greensburg and North Vernon extends in a direction very nearly parallel to Sand Creek; thus affording excellent shipping facilities to the numerous quarries situated along the banks of the creek. Switches extend from the railway to the nearest quarries at Harris City, Westport and Sherwood Crossing. A few years ago quite a number of these quarries were in active operation, but at present only the quarries at Harris City, and those near Westport are doing enough business to warrant their special consideration.

These quarries are all opened in the Laurel limestone. At their very base, however, are found one or two layers of limestone which are lithologically similar to the Laurel, so as not to be distinguishable from the same, but which, nevertheless, must be assigned to the next lower horizon, that of the Osgood beds. The evidence upon which this is done is found in the more southeastern exposures of the Osgood beds, where this upper layer is readily distinguishable from the overlying Laurel limestone, and contains a very abundant fauna, such as is generally characteristic of the Osgood beds. This upper layer of the Osgood is also quarried, and is the lowest layer ever worked in the Sand Creek quarries. Sometimes it is a fairly hard limestone, but more commonly it is a somewhat softer stone than the overlying layers, notwithstanding the influences of weathering so well, so that it can not be used with perfect safety for outside work, while

still quite satisfactory for all purposes where the stone is not exposed to extremes of temperature. It is frequently of a blue color, and is locally known as the soft blue limestone bed.

Underlying this topmost member of the Osgood formation is a soft clay layer, which is usually called the "soapstone ledge" by the quarrymen. The soapstone forms the base of all the quarries along Sand Creek. It will therefore be made the starting point of all the measurements recorded in the following lines:

Three and a half feet above the soapstone there is usually in the Sand Creek area a layer which breaks up readily into thin pieces, especially after weathering a little; it is called the flawed or the fraud ledge.

About 5 feet above the soapstone is a very good ledge of stone with a fairly even surface, known as the regular ledge. Between it and the flawed ledge is another, known as the hard ledge. These terms are sufficiently explanatory in themselves.

The 6 or 7 feet of stone immediately above the soapstone are usually free of chert, and taken all in all constitute the best stone of the quarry. The 4 feet of stone overlying this part of the section, commonly contain more or less chert, and therefore can not be very well used for work requiring considerable dressing. Some of the layers naturally contain more chert than others. One of these, about 8 feet above the soapstone, contains so much chert that it is locally known as the black diamond ledge.

The rock above the chert, that is, above the level of 10 or 11 feet above the soapstone, is usually comparatively free from chert. It is, therefore, extensively used for dressed work. About 16 feet above the soapstone one of these layers is uniformly of such thickness and of such superior quality that it is used for the best kinds of dressed work. It has received on this account the special name, "the milk-trough ledge."

About 18 or 20 feet above the soapstone the layers of rock cease to be readily separable. The rock is usually densely crinoidal and somewhat more coarse grained than the layers below. It not infrequently contains little black nodular masses, which are very hard to cut with the quarry tools. Iron pyrites are often found. It is so hard to work that it is used only for the roughest kind of work, such as cellar stones and the like. These layers of stone are known as the iron ledges. They usually have a total thickness of 6 or 7 feet. They form the least desirable part of the quarry, and their presence is rather a nuisance than a help.

Some of the quarries contain stone even higher up than the iron ledges, but this stone is the one used for footings, and other heavy work, and occasionally for a poor grade of curbings. About 28 feet above the soapstone some chert is found.

The Harris City and Layton quarries include the iron ledges. McGee's quarry extends about 5 feet above the iron ledges. The quarry of the Westport Limestone Company does not quite reach the milk-trough ledge, but the quarries of the neighboring companies extend as far as the iron ledges.

The quarries at Osgood do not include such a great vertical section as most of the quarries in the Sand Creek region. The top of the Alfred Ashman quarry is at least 2 feet below the level of the milk-trough ledge. The chert comes in at very much the same level as in the Sand Creek quarries.

The Wagner quarry, south of Osgood, with its vertical section of only $7\frac{1}{2}$ feet, extends only a foot above the level of the base of the chert layers, as exposed in the other quarries just described. This accounts for the remarkable freedom of the stone in this quarry from chert, a feature which is at once remarked by any observer accustomed to the frequent layers of chert in most other quarries of western Ripley and Decatur Counties.

The Laurel limestone in the vicinity of Laurel, in Franklin County, is sufficiently described in the body of this report to make any detailed description here unnecessary. Near the base of the Upper Quarry rock, immediately overlying the soapstone layer are found two or three layers of stone which are known to the quarrymen as the underground ledges. They do not consist of the best qualities of stone, and are usually used only for a lower grade of curbing. These underground ledges occupy the horizon just above the soapstone layer, a position usually occupied by the limestone beds at the very top of the Osgood beds in more southern localities. It is very probable that the underground beds, therefore, form in reality the top of the Osgood beds, and are to be assigned to these beds wherever they can be identified. The underground beds are usually only 10 to 15 inches thick.

About 3 or 4 feet above the soapstone layer is a layer which is known as "the spotted calf." The name is derived from the quite general presence in this layer of little chert nodules, which do not altogether interfere with its value as a mercantile product. In fact, where not much dressing is required it is a very useful stone. The very best stone in the quarry is found between the underground and the spotted calf layers. All of the stone can be used for the highest grade work.

The 3 or 4 feet of stone above the spotted calf layer are also of considerable value, but chiefly for flagging, street crossings, cellar stone and similar work. For dressed stone it is not so serviceable; the presence of chert in some of the layers being especially detrimental when stone is desired for dressed work.

Farther up chert becomes quite frequent, and the layers are often thin and much traversed by vertical seams.

THE WALDRON SHALE.

The Waldron shale is quite typically exposed at the Tunnel Mill, south of old Vernon. It is here chiefly a clayey shale exposure. On going northward the shale contains a greater proportion of limestone elements. In the neighborhood of Sandusky, at the famous fossil locality, on Conn's Fork, south of Waldron, at the George Wright locality, and at the Mary Wurtz locality, on Flat Rock Creek, and at several of the localities near Hartsville, the Waldron shale contains irregular, almost nodular, masses of limestone, which are often very fossiliferous. These irregular limestone masses are often of considerable size; some of them are 4 or 5 feet long and 1 or 2 feet thick. Usually, however, they are only about 24 to 30 inches long. The presence of these limestone masses is only another instance of a tendency which seems to be quite general in the Middle and Upper Silurian sections of this part of the State, i. e., that the corresponding rocks grow more calcareous to the northwestward. This tendency is naturally more readily detected in the case of the more shaly courses of the sections.

The tendency of the Waldron shale to become more calcareous on going northward in the State is also shown by the fact that at the localities east of Sandusky the lower part of the Waldron shale section contains a considerable amount of limestone in the form of very thin limestone courses, while still farther north the horizon of the Waldron shale is only marked by the abundant appearance of its characteristic fossils, the matrix in which these fossils appear being, however, a limestone, and the shaly character of the formation having entirely disappeared.

THE LOUISVILLE LIMESTONE.

The Louisville limestone is well exposed on Conn's Creek, south of Waldron. It is quarried at William Avery's quarry, and is a very serviceable stone for the region in which it is found. It has been found very difficult to determine the line between the top of the Louisville limestone and the bottom of the Devonian at any locality

far north of the Ohio River in the area here investigated. The Louisville limestone is not fossiliferous in most of the exposures from Vernon northward. In the few localities where fossils have been found, it has been impossible to determine the species with sufficient accuracy, and to find the fossils over a sufficient vertical distribution to make it possible to assign any appreciable thickness of limestone over the Waldron shale to the Louisville limestone. Most of the fossils that have been found have occurred just above the Waldron shale.

In the same manner the lowest fossils which could with certainty be identified with fossils from Devonian horizons have usually occurred about 25 or 30 feet above the Waldron shale. This is true of most of the localities near Vernon, in Jennings County, and near Hartsville, in Bartholomew County. In several localities south of Hartsville, however, especially at Long's Falls, it has seemed possible to refer certain fossils found within 5 feet of the Waldron shale to the Devonian fauna. Now, at William Avery's quarry, and at several other localities along Conn's Creek, farther southward, it is possible to observe a distinct unconformity between the layers here assigned to the Louisville limestone, and the beds, which with almost equal certainty are assigned to the Devonian. The degree of this unconformity is at no point very great. It is best seen at the Avery quarry itself, where it was first noticed. But the unconformity is believed to be sufficiently extended to account for the close proximity of Devonian fossils to the Waldron shale in the neighborhood of Long's Falls, near Hartsville, and the much greater thickness of the Louisville beds in the southern part of the State. Unfortunately the writer has made most of his studies on the Middle Silurian rocks of the State, and upon the Laurel beds, so much used commercially, and the overlying Louisville beds and Devonian series have not been studied as thoroughly.

The opinion which has been frequently expressed that *all* the rock overlying the Waldron shale is Devonian and that the top of the Waldron shale marks the top of the Silurian, it is believed will not stand investigation. It seems very probable, however, in the light of our present knowledge of the subject, that it will be found that the thickness of the Louisville limestone varies considerably in different parts of the State, owing to the unconformity just mentioned, and that at many points its thickness may be inconsiderable.

A careful investigation of the boundary between the Silurian and Devonian rocks of the State might be of considerable interest to any one well prepared by great familiarity with the Devonian fauna. The fossils are rare, they are often poorly preserved, and not infrequently

shown only as casts in the debatable part of the section. But higher up fossils are often shown in sufficient perfection to make up for the deficiency elsewhere, in case the difficulties of the problem here stated should cause the interest to flag temporarily.

III. THE LOWER SILURIAN NEAR LAUREL AS A SOURCE OF CEMENT.

The top of the Lower Silurian, near Laurel, consists chiefly of clayey layers, which often show loose fossils, or thin limestone courses, with fossils more or less irregularly distributed through them. In some places the clay elements predominate very much over the thin limestone courses. At Derbyshire Falls there is very little limestone in the section. At this point several local parties are interested in starting a cement factory, believing that the clayey materials which are here found in such abundance and with such freedom from other materials will be very suitable for the manufacture of cement. The following analyses were made by Dr. W. A. Noyes from material collected by the writer:

ANALYSES OF CEMENT ROCK FROM DERBYSHIRE FALLS, FRANKLIN COUNTY, INDIANA.

	I.	II.	III.
Lime (CaO)	27.13 %	38.11 %	24.44 %
Magnesia (MgO)	15.15 "	7.71 "	9.81 "
Silica (SiO ₂)	11.57 "	9.25 "	21.51 "
Ferric oxide (Fe ₂ O ₃)	1.56 "	1.85 "	2.69 "
Alumina (Al ₂ O ₃)	4.58 "	2.95 "	8.32 "
Potash (K ₂ O)	1.03 "	0.84 "	1.91 "
Soda (Na ₂ O)	0.10 "	0.07 "	0.16 "
Loss by ignition (CO ₂ and H ₂ O)	38.81 "	39.03 "	31.38 "
Total	99.93 %	99.81 %	100.22 %
RATIONAL ANALYSES.			
Calcium carbonate (CaCO ₃)	48.45 %	68.13 %	43.64 %
Magnesium carbonate (MgCO ₃)	31.80 "	16.19 "	20.60 "
Silica (SiO ₂)	11.57 "	9.25 "	21.51 "
Ferric oxide (Fe ₂ O ₃)	1.56 "	1.85 "	2.69 "
Alumina (Al ₂ O ₃)	4.58 "	2.95 "	8.32 "
Potash (K ₂ O)	1.03 "	0.84 "	1.91 "
Soda (Na ₂ O)	0.10 "	0.07 "	0.16 "
Combined water	0.84 "	0.53 "	1.39 "
Total	99.93 %	99.81 %	100.22 %

The analyses are based on the material dried at 135° C. The iron is partly, at least, in the ferrous state, and probably in part ferrous carbonate, but the two forms of iron were not separated.

Sample No. I. was obtained 3 feet 9 inches below the base of the Clinton, on the southern side of the quarry. It contained many worm-borings, and had a decidedly bluish appearance. It did not have a very uniform texture, and did not promise to be a very valuable layer. Its total thickness was also rather small.

Sample No. II. was obtained 10 feet below the base of the Clinton. It was a fossiliferous clayey layer. The presence of considerable lime was shown by the white color of the fossils, but the grayer color of the remainder of the rock suggested that the lime was probably not uniformly distributed.

Sample No. III. was obtained 12 feet below the base of the Clinton. It was a very even grained rock, fairly soft, and weathered back. About 2 feet of this material constituted the layer, but there was quite a considerable amount of this rock and also of rock similar to sample II. in the section.

For instance, 5 feet of rock similar to sample II., with plenty of fossils, occur just below the layer from which sample III. was derived. And just below this are 5 feet of rock similar to sample III.; the rock in this case is again worn back under the more fossiliferous layer. The pool at the bottom of the falls is 32 feet below the Clinton.

The analyses indicate that the clays at the top of the Lower Silurian can be used as a source of cement, but the cement will not have the qualities of the best cements, such as the Portland cements. The percentage of magnesium carbonate is altogether too large to furnish this quality of cement. The percentage of alkalies is also too large. But the clay will make a very fair grade of hydraulic cement, and there is such an enormous amount of material at the falls and the cement can be produced so cheaply that in the hands of experienced hydraulic cement producers the manufacture of cement at this point might become a considerable source of revenue.

IV. A DETAILED DESCRIPTION OF THE GEOLOGY OF THE VARIOUS LOCALITIES EXAMINED, WITH SECTIONS OF ALL THE IMPORTANT QUARRIES AND A STATEMENT OF THE USES TO WHICH THEIR STRATA ARE PUT.

It has been considered desirable to give a very detailed account of the various layers found at all the important quarries and to state the uses to which their various strata are put. The various strata in the same quarry differ so much in thickness and general value that no general description adequately reveals the possibilities of each quarry. As far as general descriptions serve any purpose the various accounts of the Laurel limestone in the earlier parts of this report have already

provided material. On the following pages will be found not only a description of the general geological conditions under which every quarry opening is found, but the character of each individual layer and the uses to which it is applied, are given as circumstantially as may be profitable in each case. Where quarries are remote from all railroad connections or have been but little operated the statements are often much less detailed. It is believed that all the more practical data are here given. Regarding the practical working of the various quarries the methods are all very primitive, excepting in the quarries already specified in the earlier part of this report which have switch connections with the railroad, and which employ steam drills, steam channelers, steam pumps and steam-operated derricks. In several cases traveling steam cranes placed on the tracks of the switches entering the quarry are employed. No other outfit was noticed at any quarry. The quarries supplied with the various conveniences just enumerated are, of course, able to lead in the competition for orders for stone, excepting in the few cases in which other quarries have natural advantages, owing to a great number of layers of stone of the particular thickness desired, or which are located at no great distance from the point to which the stone is to be shipped.

RIPLEY COUNTY.

A. OSGOOD.

104. Alfred Ashman's Quarry, Osgood.—The following section is at present exposed at this quarry:

*Laurel
Limestone.*

- 12-18 inches of rough stone used for rubble.
- 4 inch layer, used for curb and sidewalk; this layer contains the most flint of any layer in the quarry.
- 11 inch layer, capping into a 6 and a 5 inch layer, working up into 5 and 4 inch curbs.
- 8 inch layer, with some flint, used for footings.
- 14 inch layer, with hardly any chert, capping into two 7 inch curbs.
- 10 inch layer, capping into two 5 inch layers, both containing chert, especially the lower one; both used for curbs. This is about the level of the top of the Wagner quarry south of Osgood.
- 6 inch layer, used for footings, sidewalks and rubble.
- 8 inch layer, containing a little chert; used for footings and rubble only.
- 11 inch layer, used for good curbing, after capping into a 4 and a 7 inch layer.

- Laurel Limestone, Continued.* { 11 inch layer, capping into a 4 inch layer used for sidewalks, and a 7 inch layer, used for gutter stone; it is too cappy for other purposes.
 { 5 inch layer, used for curbing and sidewalks.
 { 9 inch layer, used for curbings, water tables and ashlar.
 { 8 inch layer, used for curbings, water tables, ashlar.
 { 3 $\frac{1}{2}$ inch layer, used for sidewalks, flagging and 3 inch curbs.
 { 9 inch layer, used for curbs, sills, water tables and all kinds of first-class dressed work.
 { 16 inch layer, used for 12 inch water tables, and after capping into two 8 inch layers, it is used for caps of piers; it may be trimmed to 5 inch flags and curbs.

Osgood Limestone. { 10 inch layer, used for curbing, all kinds of dressed work, such as water tables and also for gutter work.
 { Below this is the shaly clayey stone which occurs constantly a short distance below the top of the Osgood beds.

DECATUR COUNTY.

B. WESTPORT.

Westport Limestone Quarries.—A little over half a mile directly west of locality 194, described in the report for 1896, is the terminal of a switch, which leads from the railroad half a mile south of Westport eastward to the banks of Sand Creek. The following limestone companies are situated here: The Westport Limestone Company, Samuel A. Hollinsbe, proprietor; the Hollinsbe Stone Company, Ira J. Hollinsbe, Superintendent, and the Sand Creek Limestone Company, M. H. Sample, President, and O. H. Stout, Secretary.

The quarries nearer the creek have gone far enough into the hillside to expose the iron ledges. The section at the Westport Limestone Company is more limited, the topmost ledge now exposed being 30 inches below the level of the iron ledges. The following section was taken at this quarry:

- Laurel Limestone.* { About two feet of clay.
 { 6 inch layer used for curbing and flagging.
 { 16 inch layer capping into a 5 inch layer used for curbing and a 11 inch layer used for footings and light bridge stone.
 { 9 inch layer used for steps, sills and caps; it is especially adapted for fine steps.
 { 18 inch layer capping into two 9 inch layers, used for footings and bridge stone.

*Laurel
Limestone,
Continued.*

- 6 inch layer, locally known as the regular 6 inch ledge, used principally for flagging, and also for curbing.
- 15 inch layer capping into a 4 inch layer used for curbing, flagging, jail flag and window sills; a 5 inch layer used for similar purposes; and a 6 inch layer used for flagging and bridge backing. The last named ledge is locally known as the flawed or fraud ledge, on account of the ease with which it breaks up into irregular pieces.
- 21 inch layer capping into a 9 inch and two 6 inch layers, used for curbing, steps, fine bench work, fence coping and jail work.
- 6 inch layer, used for curbing and flagging; blue.

*Osgood
Beds.*

- 14 inch layer of soft stone, an inferior stone which has been used for curbing but which should not be used at all.
- 12 inch layer of clay rock, locally known as the soapstone ledge. This ledge is quite constantly found near the upper part of the Osgood beds.
- The underlying Osgood stone is of no value commercially, but has been worked by former quarrymen with the view of ascertaining their quality. The following thicknesses of layers were established at this time: 7, 14, 16, 6, 26 inches which would cap twice, and a 12 inch layer. Below this are 48 inches of solid rock with no sign of capping, corresponding to the Madison-like rock often found forming the lower half of the Osgood section in this part of the State.

John J. Layton's Quarry.—About three miles northward, on the western side of the creek, is the John J. Layton quarry.

The quarry has not been operated extensively for several years. A very good exposure is, however, presented by the former workings, and the following section is well exposed:

*Laurel
Beds.*

- Several feet of clay.
- 7 feet of limestone without good bedding, used only for crushed stone for road beds; known locally as the iron ledges.
- 3½ inches of curbing.
- 11 inch layer, known locally as the milk trough ledge; used for water tables, steps, veranda blocks.
- 7 inch layer, capping irregularly into thin flagging.
- 14 inch layer capping into a 5 inch layer, used for flagging and curbing; and a 9 inch layer used for curbing, fine steps and veranda blocks.
- 17 inch layer capping into a 3 inch flag or curb; a 1 inch scale; a 7 inch layer used for 5 inch curbing; and 6 inches of stone used for flagging or poor gutter stone.

*Laurel
Beds,
Continued.*

- 6 inch layer, used for curbing, gutter or flagging stone.
- 9 inch layer used for jail flag, jail flooring and for cells.
- 4 inch layer with chert on the bottom, used for flag.
- 9 inch layer with chert; can be used only for crushed stone for road beds.
- 4 inch layer, used for flag.
- 4 inch layer, used for flag.
- 6 inch layer, used for gutter flag and footings; it contains chert on the bottom.
- 6 inch layer with chert; can be used only for crushed stone.
- 6 inch layer, used for gutter flag.
- 5 inch layer, cherty.
- 2 inch layer, used for a poor quality of scrap flag.
- 7 inch layer capping into a 4 inch layer used for flag and not good enough for curbing; and a 3 inch layer used for similar purposes.
- 13 inch layer capping into a 4 inch layer used for flag and curbing; a 6 inch layer used for gutter stone and flag, not good for curbing; and 3 inches used for flagging, and a good quality of curbing.
- 5 inch layer, locally known as the regular ledge, used for flagging and curbing.
- 9 inch layer, forming the hard ledge, capping into a 5 and a 4 inch layer, used for flagging and curbing.
- 4 inch layer, used for flagging, poor quality, owing to readily breaking up in an irregular manner.
- 6 inch layer, locally known as the flawed ledge; as the name implies, the stone is of inferior value, breaking up irregularly.
- 21 inch layer, capping into a 4 inch layer, under which is a second 4 inch layer, both used for flagging and curbing; and two 6 inch layers used for gutter flag. This is the lowest layer which will stand weathering.
- 6 inch layer, good for 4 inch curbing.

*Upper Part
of the
Osgood Beds*

- 14 inch layer capping into two 7 inch layers of blue stone of very inferior quality, notwithstanding the influences of weathering.
- 16 inch layer of clayey rock, known locally as the soap-stone ledge; this is the blue clayey layer which so readily disintegrates into a clay bed, where long exposed to the influences of weathering. It belongs to the upper part of the Osgood beds, the 14 inch layer overlying the same being also a part of the Osgood beds, although not to be distinguished from the overlying Laurel beds so far north of the typical Osgood beds.

C. HARRIS CITY.

Harris City Quarry.—The following section is exposed in the extensive quarries located in this area:

*Laurel
Limestone.*

- Several feet of clay.
- 6 feet of hard limestone with poor planes of separation along the bedding, locally known as the iron ledges.
- 18 inch layer, used for bridge blocks and bases.
- 5 inch layer, used for flagging.
- 16 inch layer, locally known as the milk trough, used for bases, piers and general bridge work.
- 9 inch layer, used for flagging.
- 18 inch layer, used for bridge bases.
- 17 inch layer, used for bridge work and pier blocks; after capping into 10 and 7 inch layers it is used for range work and water tables.
- 12 inch layer, used for coping, pier blocks and pier caps.
- 9 inch layer, used for range work and good solid water tables.
- 8 inch layer, used for curbing after capping into two 4 inch layers.
- 7 inch layer, used for good solid curbing and flagging.
- 13 inch layer, used for bridge work; after capping into 7 and 6 inch layers, it is used for gutter and curb stones; a few white spots of chert are present.
- 5 inch layer, used for curb or flag.
- 32 inch layer of a cheap grade of stone, with chert, used chiefly for footings; it caps into 8, 12 and 10 inch layers.
- 11 inch layer; this is the top of the very best stone; after capping, the 4 inch layer is used for very good curbing, and the 7 inch layer for flagging and crossing, but this layer is not good for curbing.
- 6 inch layer, used for curbing and flagging; a good solid layer.
- 4 inch layer, used for 4 inch curbing; solid.
- 7 inch layer, used for curbing and flagging; it has two thin shells on the bottom.
- 5 inch layer, used for flagging, sidewalks, jail flooring and ceiling, curbing and crossing.
- 21 inch layer capping into a 1½ inch shell; a 9½ inch layer used for water tables, range work and pier caps; a 6 inch layer used for curbing and flagging; and a 5 inch layer, used for flagging.
- 1 inch shell.
- 6 inch layer, used for flagging, jail flooring and cellar flagging; too soft for sidewalks.

<i>Osgood Beds.</i>	{	14 inch layer capping near the middle, used for curbing, gutter stone, jail flag; too soft for outside work.
		14 inch layer, locally known as soapstone.

The Clinton is exposed at Parker's Mill (188), about a mile south of Harris City. A short distance south of Harris City a road turns off from the pike and crosses the creek eastward. Just below the bridge the base of the Osgood beds is exposed in the bed of the stream. It is a brown stone layer about 1 foot thick. The lower overlying Osgood beds are not exposed, but about $4\frac{1}{2}$ feet higher about 3 feet of poor limestone, with clayey courses, such as are characteristic of the Upped Osgood beds in this part of the country, are shown. Seven feet and six inches above the brown limestone exposed in the creek bed a blue clay layer, 1 foot thick, is exposed. This layer and the overlying layer of limestone may be traced northward along the creek to a short distance below the quarry. This blue clay and possibly the overlying layer of limestone are to be included in the Osgood bed, but if this be the case this limestone bed can not be distinguished lithologically or paleontologically from the overlying Laurel beds.

As far as may be judged from conversation with the quarrymen the upper shale or clay is known to them as the soapstone ledge, and seems to be harder where reached in their quarrying operations. It is said by them to be 16 inches thick. The overlying limestone layer is 14 inches thick, and is considered a good quarry stone.

According to barometrical measurements the level of the Clinton, at Parker's Mill is 155 feet below Greensburg, or 800 feet above sea level.

D. NEW POINT, ST. MAURICE AND NORTHWARD.

201. New Point Quarries.—A mile north of New Point, east of the road, along a branch of Salt Creek, and a quarter of a mile west of Rossville, are the Big Four quarries. The following section is here exposed.

<i>Laurel Limestone.</i>	{	5 to 10 feet of clay.
		1 to 3 feet of rip-rap, with chert.
		3 inch layer, used for well-stone and light rubble.
		12 inch layer, capping into 4, 4 and 3 inch layers, used for curbing and footings.
		8 inch layer, used for footings, walk-stone, gutter-flag and street-crossings; near the middle this layer contains chert nodules.
		8 inch layer, with the same uses as the preceding, but consisting of a somewhat better quality of stone.

*Laurel
Limestone,
Continued.*

- 8 inch layer, with the same uses as the two preceding.
- 15 inch layer, capping into an eight and a 6 inch layer.
This layer is roughly seamed near the middle, and contains some white chert.
- 7 inch layer, used for footings.
- 6 inch layer, used for fine dressed work, window sills, etc.
- 8 to 10 inch layer, used for footings and dressed work.
- 4 inch layer, used for flagging, curbing and ashlar.
- 4 inch layer full of chert, used for rubble. Sometimes the two 4 inch layers hang together, and contain less chert; they are then used for footings, curbs, culvert crossings and pier blocks.
- 10 inch layer, known locally as the regular layer; it contains chert and is used for footings.
- 2½ inch layer, used for thin scrap and sidewalks.
- 9 inch layer, used for all kinds of dressed work, from street to building purposes. It caps into a 6 and a 3 inch layer; the stone is then used for copings, sidewalks and curblings.

*Osgood
Beds.*

- 16 inch layer, used for heavy coping, pier blocks and other bridge work. It caps into a 9 and a 7 inch layer, and is then used for steps, curbing, door sills and water tables. The stone is streaked horizontally with more argillaceous layers.
- 20 inch layer of clay, or shaly clay, locally known as soap-stone.
- 12 inch layer, often with 4 inches of clayey stone on top and with the lower 8 inches rough, and used only for rip-rap and foundations.
- 24 inch layer, used for bridge work, chiefly for bridge backing and other interior work. Argillaceous and limestone courses are combined in a sort of streaked fashion.
- 12 inch layer, used only for footings.
- 40 inch layer, used for bridge work; consisting of clay and limestone in streaks; sometimes the lower 10 inches may be capped off, and form a fairly good stone for footings and bridge copings.
- 6 to 8 inch layer, with about 5 inches of good stone, used for rubble, footings and curbing.
- 33 inches of Clinton rock.

The level of the top of the Clinton lies about 25 feet below the railroad at New Point.

203. *St. Maurice.*—About 3 miles north of Rossville is *St. Maurice*. Nearly a mile southward one of the branches of Salt Creek exposes the Clinton. At least 4 feet of salmon-brown rock are exposed, but this is probably not the total thickness. The Osgood beds are exposed in the branch a short distance eastward.

204. About half a mile east of St. Maurice the Clinton is better exposed in another branch of the same stream. It is here $5\frac{1}{2}$ to 6 feet thick; it has a salmon brown color, contains white lenses of a finer grained limestone, the latter often occurring as irregular layers or patches of small extent. Below the Clinton are 8 inches of white clayey, nodular limestone, containing, near the top, salmon-colored crinoidal fragments.

The top of the Lower Silurian limestone ledge just beneath shows good strong wave marks, with a trend of north, 15° east.

205. Larkin Walter's Quarry.—About two miles east of St. Maurice and about two miles north of this line, the line between Decatur and Franklin counties crosses another branch of Salt Creek. Between 5 and 6 feet of salmon brown Clinton are exposed a short distance south of the road crossing. The Osgood beds are seen in the banks of the stream. The Laurel formation is seen at Larkin Walter's quarry, a short distance northward. The stone is used for local purposes.

E. SANDUSKY AND FLAT ROCK EXPOSURES.

Sandusky.—About a quarter of a mile east of Sandusky the road crosses the southern branch of Clifty Creek. Several hundred yards up the creek is located a quarry, known as Meek's quarry. The Waldron is here well exposed and contains numerous species belonging to the characteristic Waldron fauna. The upper 2 feet of the Waldron shale contain few fossils. Below these lie 3 feet of clay, with thin, intercalated limestone layers, both the clay and the limestone containing numerous fossils. Under these lie $2\frac{1}{2}$ feet of poor clayey rock, which contain no fossils, but form a lithological gradation between the Waldron shale and the Laurel beds below. The stone from this level down to the chert beds is a very good quality of limestone for this part of the country, and is the stone sought in this quarry.

Overlying the Waldron shale is a stone which seems to be a very sandy limestone. The same layer is found in the bottom of Sand Creek, about half a mile east of Greensburg.

Between Meek's quarry and the bridge east of Sandusky is located a deep hole in the stream bed, which is known as Douglas Hole. At this point the horizon of the Waldron shale is variously occupied by thin clay layers; by clay with frequent thin intercalated limestone layers, full of fossils; and occasionally by solid white limestone masses which contain the fossils in a matrix formed by the very fine grained material, of which the limestone is composed. These limestone

masses are always very irregular in form, sometimes coarse lenticular masses, and the color is often light blue, rather than white. Masses of this kind are also found in the regular Waldron shale at the famous fossil locality on Conn's Creek, south of Waldron. They show a manifestation on the part of the shale to become more of a limestone formation on going northward in the State; for the Waldron shale in the southern part of Indiana does not contain this limestone, even in the form of irregular masses, while at Sandusky and at various localities on Conn's Creek and Flat Rock Creek the limestone masses just described are not uncommon. In some of the more northern counties of the State the horizon of the Waldron shale is quite well marked, but it is here represented only by a series of very fossiliferous limestone layers, which contain the very characteristic Waldron fauna.

At Douglas Hole the limestone below the Waldron horizon is very crinoidal. The upper layers of this stone contain numerous Waldron fossils. The total thickness down to the level of cherty beds is about 6 feet. There is a considerable thickness of cherty limestone.

The measurements at the bridge east of Sandusky for this same section are very different. Here at least 13 feet of limestone, free from chert, are exposed beneath the level of the Waldron shale before the first chert layer is reached. This layer is about 4 inches thick. Beneath this are 9 inches of limestone, the lowest layer exposed at this point. Near the middle of this section were obtained *Pisocrinis gemmiformis* and a pygidium of some species of *Illanus*. It is evident that some of the layers which contain chert at Meek's quarry, Douglas Hole, and at the bridge north of Sandusky are free from chert at the bridge east of Sandusky. This failure of the chert to appear at the same levels in closely contiguous localities is very instructive in relation with the problem as to the origin of the chert beds in the Laurel formation in Indiana.

East of the railroad bridge north of Sandusky the Waldron shale is again very well exposed. It is here 4 or 5 feet thick, and is overlaid by a sandstone or sandy limestone layer about 1 foot thick. Below the Waldron shale there are about 6 feet of crinoidal limestone. Underlying this are 4 inches of chert, 1 foot of limestone, and then 8 feet of cherty limestone. This section corresponds very nearly with the section at Douglas Hole. The cherty limestone is best exposed west of the bridge crossed by the pike, north of Sandusky. The top of the Waldron shale lies 6 feet below the level of the railroad bridge.

Flat Rock Creek Exposures.—In section 4, Adams Township, about 3 miles west of Sandusky, about 15 feet of very cherty limestone are exposed on the north side of the creek and form a vertical bank. It is

correlated approximately with the cherty layers near Sandusky. A quarter of a mile southward from the last locality is found the Sandusky-Downeyville Pike.

One mile west of the last locality, on the north side of the stream, near a stone bridge, about 12 feet of stone of fair quality have been quarried for the abutments of the bridge. It contains but little chert. Nevertheless the geological horizon of this stone should differ but little from that of the cherty beds at the locality last described.

Downeyville.—Along the creek south of Downeyville the 5 feet of stone above the creek bed are of inferior quality. At their top is a thin layer, containing *Pisocrinus gemmiformis* and *Atrypa reticularis*. The $4\frac{1}{2}$ feet of limestone overlying this bed form the building stone of this region, but the stone is bluish and much inferior to the fine stone at the Lemon quarry on Big Flat Creek, to which it is equivalent. Overlying this are 2 feet of stone with occasional chert layers and nodules, and, therefore, of inferior quality. Above this are 4 feet of white limestone, which in this locality do not seem to be of value.

Jarett R. Lemon Quarry.—This quarry is located a mile north of Downeyville, on Big Flat Rock Creek, south of the creek and east of the road. As at the last locality, the good quarry stone is found beneath the cherty beds, and the overlying beds are of inferior quality. The good quarry stone is $5\frac{1}{2}$ feet thick, the overlying cherty beds are 2 feet thick, and the upper inferior limestone is $11\frac{1}{2}$ feet thick; total, over 19 feet. The beds belong near the middle part of the Laurel limestone. The following descending section will give a better notion of the commercial value of the rocks exposed in the quarry:

	4 feet of water worn and weathered stone, irregularly seamed and evidently of inferior value.	
	10 inch layer.	
	3 inch layer.	
	5 inch layer.	
	8 inch layer.	
	2 inch layer.	
	4 inch layer.	
Laurel Limestone.	3 inch layer.	Stone only fairly good, and there- fore not quarried to any great extent.
	3 inch layer.	
	9 inch layer.	
	$3\frac{1}{2}$ inch layer.	
	$3\frac{1}{2}$ inch layer.	
	4 inch layer.	
	11 inch layer.	
	8 inch layer.	
	13 inch layer, would probably split up.	
	3 inch layer of irregular stone.	

*Waldron
Shale.*

{ 6 feet of clay.

{ 8½ inch layer.
4½ inch layer.
3 inch layer.
5 inch layer.
4½ inch layer.

} Softer limestone, blue, somewhat
magnesian.

{ 10 inch layer.
8 inch layer.
5 inch layer.
6 inch layer.
6 inch layer.
5 inch layer.
6 inch layer.
7 inch layer.
7 inch layer.

} Very good stone for building purposes.

2 feet of white limestone; poor.

6 1-3 feet of limestone with frequent chert layers, excellent as rubble for road purposes. Base of upper quarry.

15 feet of limestone not good for building purposes because not coming out in good layers, but quarried for rubble for roadbeds, and formerly used for making lime.

*Laurel
Limestone.*

11 inch layer

4½ inch layer

12 inch layer with chert nodules.

12 inch layer. The stone from the base of the chert beds down to this level is exposed above the middle quarry, but is at present not worked.

8 inch layer, the top of the portion of the middle quarry now worked.

24 inch layer.

8 inch layer.

8 inch layer.

10 inch layer.

9 inch layer.

12 inch layer.

48 inches of limestone which split up into layers varying from 4 to 8 inches in thickness.

24 inch layer, solid. Base of middle quarry.

24 inch layer capping into 12 inch layers, at present being entered at the middle quarry.

} Excellent
building
stone.

- | | | |
|-----------------|---|--|
| Osgood
Beds. | { | 14 inch layer capping into 7 inch layers, exposed in the lower quarry only. It is said to be a white limestone and is the base of the fine building rock. |
| | | 30 inch bed capping into a 12 and a lower 18 inch layer. The stone is said to be brownish, and to resemble the underlying layer. It was formerly worked in the lower quarry. |
| | | 14 inch layer, argillaceous limestone, of brown color where weathered. |
| | | 3 feet of blue shale, locally called soapstone. |

The Osgood beds were formerly worked in the lower quarry. The best building stone is near the base of the Laurel bed. The next best stone is from the upper part of the Laurel bed. The middle part of the Laurel bed is spoiled by the presence of considerable chert. The Osgood bed consists of of an inferior quality of stone.

Towards the railroad the Waldron shale is overlaid by $3\frac{1}{2}$ feet of limestone, weathering brownish, and containing *Cladopora*, *Syringopora* and *Favosites*. While the species could not be identified with certainty, Mr. G. K. Greene thought they had a Niagara facies, and the limestone is therefore considered part of the Louisville bed. The base of the Waldron shale is about 831 feet above sea level.

SHELBY COUNTY.

G. WALDRON TO GENEVA.

William Avery's Quarry, Waldron.—A mile and a quarter south of Waldron, on Conn's Creek, is the famous locality from which Prof. Hall secured the many fossils which have made the Waldron horizon so famous. The diggings were made on the western side of the creek, but so much time has elapsed since the last collectors have attempted to exploit this place that the fossil-bearing part of the shale is no longer well exposed. Directly east of the fossil locality is the quarry. The Waldron shale forms the base of the quarry. The shale and the overlying limestone slope towards the northwest at the rate of $7\frac{1}{2}$ feet in one hundred. The limestone is conformable to the Waldron shale below; in the northern part of the quarry a section of 8 feet was measured. In the northwestern part of the quarry its thickness must once have been greater, but at present its surface in that direction does not admit of measurement. In the southeastern part of the quarry its thickness is considerably less than 8 feet, owing to the fact that the upper surface of the limestone was considerably eroded before the deposition of the next overlying beds.

The erosion of the upper surface of the limestone and the tilting of the beds have been of such a character that notwithstanding the evident unconformity the beds above the unconformity have at present a practically horizontal position, while the underlying beds are tilted towards the northwest. The limestone below the unconformity is quarried as a very fair quality of building stone, the lower beds making good curbing, flagging and coping, and consisting of light brown limestone, while the upper beds are of a darker drab or blue color and do not quarry out in nice slabs, forming only an inferior quality of stone. The stone overlying the unconformity is apparently a very argillaceous limestone; it resembles a fine-grained sandstone in texture, and has a brown color, due to weathering.

There seems to be no reason for excluding the limestone overlying the Waldron shale from the Niagara group; fossils have been found in similar positions at St. Paul, which are certainly of Niagara age. But the geological position of the limestone overlying the unconformity is much less evident. I shall call it for the present the Shelby bed. It may possibly represent in this region the base of the Devonian. At any rate the unconformity may be traced for several miles down the creek and the overlying argillaceous limestone may be recognized in the neighborhood of Hartsville, in Bartholomew County.

The following section was taken in the northeastern part of the quarry, where the best stone is obtained at present:

<i>Lower Devonian.</i>	{	2 feet of argillaceous limestone having the appearance of a fine-grained sandstone.	} Stone of moderate value, not coming out in good slabs.
		2 feet of brown limestone of no value.	
		8 inch layer capping into 3 and 5 inch layers.	
		6 inch layer.	
		10 inch layer capping into 2 and 8 inch layers.	
		4 inch layer.	
<i>Louisville Bed.</i>	{	10 inch layer capping into two 5 inch layers.	
		7 inch layer.	
		2½ inch layer.	
		8 inch layer.	
		8 inch layer.	
		5 inch layer.	
		12 inch layer capping into two 6 inch layers.	
		7 inch layer.	
		5 inch layer.	
		4 inch layer.	
			} A good quality of stone especially for curbing and flagging.

Waldron {
Shale. { 6-8 feet of shale.

George Wright Locality.—About 2 miles southwest of the William Avery quarry and three-fourths of a mile below the junction of Conn's Creek with Flat Rock Creek, is the house of George Wright. A road comes down to the creek just south of this house and the Waldron shale exposed along the eastern side of the creek just north of the road is very fossiliferous. The overlying limestone has weathered into a brown rock.

Mary Wurtz Locality.—About one mile down the stream from the George Wright locality and $1\frac{1}{4}$ miles above Geneva, is the former Mary Wurtz farm. Along the western bank of the creek the Waldron shale is poorly exposed. This used to be a very fine fossil locality, but at present only serves to show the presence of the shale. The limestone above the Waldron shale and correlated with the Louisville bed is here only $5\frac{1}{2}$ feet thick, and was formerly quarried. The Shelby bed overlying the same may be seen to be unconformable to the limestone below, after having studied the locality at Avery's quarry. It here contains traces of fossils, but these are in the form of exterior casts left by the leaching away of the lime of the fossils themselves, and are very poor.

Geneva.—A short distance above the bridge, on the west side of Flat Rock, near Geneva, is the Gregory lime quarry. About 31 feet of limestone are exposed above the level of the massive brown limestone which forms the lower part of the Shelby bed. It is a strongly dolomitic stone and has a brownish or bluish color in the different courses. Its bedding is irregular, and it is not suitable for a building stone, excepting for neighborhood purposes. It is said to burn into a very good quality of lime, and was operated for this purpose at the time the quarry was examined. The more massive dark brown rock, which evidently forms the base of the Shelby bed, is well exposed a short distance farther up the creek. It apparently reaches the creek level near the quarry.

RUSH COUNTY.

H. MILROY.

Milroy.—At the bridge directly west of Milroy the Waldron shale is only 1 foot 6 inches thick. It is overlaid by $5\frac{1}{2}$ feet of poor agrillaceous limestone. At Ben Rardin's quarry, about half a mile south of Milroy, the Waldron shale thins out to about 6 inches near the southern end of the quarry. About $7\frac{1}{2}$ feet of limestone are exposed

beneath this level, only the lower part of this containing chert. While most of this stone is of considerable value locally for cellar stone, flagging and curbing, it is at present but little employed except for crushed stone for roads.

JENNINGS COUNTY.

I. VERNON.

Tunnel Mill, Vernon.—The Upper Devonian rocks are very well shown by the exposures along the road leading from the Tunnel Mill eastward towards Vernon. The black shale forms the top of a hill, over which the road passes. The middle part of the section is seen on going down the hill, eastward and westward. The lower part is exposed along the northern side of the creek, near the southwestern outskirts of the town. All of these sections have been combined in the following continuous section:

<i>Black Shale.</i>	{	About 25 feet exposed; the total section of shale not exposed.
	{	4 inch layer; fine-grained impure limestone, blue.
	{	30 inch bed of crinoidal limestone; fossils.
<i>Crinoidal, and Brachi- opodal Lime- stone.</i>	{	18 inch layer of dark-blue limestone, without fossils; represented east of the hill summit by shaly dark limestone.
	{	10 inch layer of limestone containing black nodular masses, and numerous fish teeth; also the brachiopods found in the next lower layer.
	{	54 inches of crinoidal limestone with many brachiopods. West of the hill summit this bed contains several thin chert layers with well preserved fossils.
<i>Banded Limestone.</i>	{	96 inches of closely banded limestone; correlated with the cement rock in southern Indiana.
	{	96 inches of limestone containing corals at various levels; these are in the form of much rounded fragments near southwestern Vernon, but consist of better preserved remains in the section east of the Tunnel mill. The lower third of this limestone is often weathered so as to leave cavernous openings.
<i>Coral Beds.</i>	{	6 inch layer of closely banded limestone; usually without fossils.
	{	108 inches of limestone with coral remains, the corals being best preserved in the Tunnel mill section.

- Lower Devonian.* { 148 inches of massive rock, the lower 4 feet of which often are softer, showing a peculiar vertical system of fracture which causes the lower part of this rock to scale off and allow the upper part to project. This lower rock is blue in color.
- Of Uncertain Age.* { 58 inches of limestone; the upper 3 feet consist of hard rock forming a projecting ledge; an 8 inch layer lies beneath, and the 14 inch layer below the last contains worm borings. The lower layers are composed of blue argillaceous limestone.
- Waldron Shale.* { 66 inches of thin, blue, clayey shale, containing fossils.
14 inches of bluish, hard argillaceous rock.
- Laurel Limestone.* { About 10 feet of Laurel limestone are exposed here, the total section not being seen.

North Vernon.—The following very instructive section of Devonian rocks is exposed along the road leading from North Vernon north-eastward to the waterworks pumping station:

- Black Shale.* { Total section not exposed.
- Crinoidal and Brachiopodal Limestone.* { 48 inches of blue, shaly limestone with brachiopods, bryozoans, and a few corals. This bed is represented by crinoidal limestone on going a short distance eastward along the quarried face of the hill.
15 inch layer of crinoidal limestone with numerous fish teeth well shown south of the pumping station.
44 inches of buff limestone, full of brachiopods. North of the pumping station on the other side of the road it contains large irregular masses of chert.
There is evidence of erosion in the underlying beds previous to the deposition of the last described bed.
- Banded Limestone.* { 55 inches of closely banded limestone, with shaly partings; dividing into 12, 11, 26 and 6 inch layers.
72 inches of buff and blue limestone, inclined to be massive, but often giving evidence of close banding. Small irregular cracks filled with calcite often traverse the rock. This is part of the once famous North Vernon limestone.
42 inches of closely banded limestone. This is probably equivalent to that part of the coral section as described from Vernon, which lies above the banded limestone, there seen a little above the middle of the coral beds.
- Coral Beds.* { 48 to 60 inches of limestone with frequent coral remains.
- Lower Devonian.* { 120 inches of massive buff limestone.
54 inches of dark-brown limestone, with rare traces of corals.

surface of the woods, although the area of exposure is small. In a little run east of the fence, near the west end of the woods containing the last named exposure, a foot of limestone overlies the *Conocardium* layer; it contains a considerable number of corals. Above it lie 3 feet 8 inches of a very fine-grained white limestone, with abundant close bedding, very much resembling the finer grained rock at the base of Case's quarry.

As already stated, the cherty or quartziferous layer probably represents in a measure the coral bed of more southern localities, while the *Conocardium* bed belongs to the upper part of the coral bed, or still more probably, to the lower part of the banded limestone. The occurrence of the banded limestone still farther up in the section is of interest in this connection.

Long's Falls.—The Waldron shale may be readily followed along Clifty Creek, from Hartsville southward to the Tarr Hole, half way between Hartsville and Newbern. Some of the best fossil localities now accessible in this shale occur in this region. One good fossil locality is on the west side of the creek, a mile south of Hartsville, on the farm belonging to Francis A. Crump. A little stone is being quarried on the north side of a small branch near its junction with the creek, and a short distance farther up the branch the Waldron shale contains many fossils. Another locality is found a quarter of a mile southward, along the northern and eastern margins of the cornfield northeast of the bridge which crosses the lower end of Middle Fork, near its junction with Clifty Creek. A quarter of a mile southwest of this bridge, at Tarr Hole, is another good locality. The Waldron shale is exposed along the branch entering Clifty Creek at the bridge, up stream as far as two falls, situated upon two forks of the branch. The more northern of these is Long Falls, on Middle Fork. Just below the falls the upper part of the Laurel limestone is quarried to a moderate extent for building purposes. At the falls the Waldron shale forms the lower vertical part of the fall. The overlying rock forming the upper part of the fall and the bed of the stream above the fall is a poor limestone of light-brown color, containing no fossils in the lower five feet of its exposure, but with a fair number of corals in a layer just above this level. While these fossils are not well preserved, Mr. G. K. Greene was able to recognize in the material submitted to his examination *Favosites limitaris* and *Cladopora cryptodens*. Of course this indicates that the rock within five feet of the Waldron shale is Devonian at this locality. The five feet of rock above the Waldron shale remain of uncertain age.

GEOLOGICAL MAP OF
EASTERN FRANKLIN
COUNTY AND
ADJACENT DECATUR
COUNTY, SHOWING
THE BOUNDARY
BETWEEN THE UPPER
AND LOWER
SILURIAN ROCKS.

By AUG. F. FOERSTE.
Scale, 2 miles to the inch.



Anderson Falls.—A mile south of Long Falls, on Fall Fork, is Anderson Falls. The Waldron shale a short distance below the falls has furnished the best fossils found in this shale in Bartholomew County. Immediately above the shale the brown limestone which corresponds to the limestone already described from Long Falls is found. Near the sides of the stream bed, just above the falls, traces of corals are found, but these are not well enough preserved for purposes of correlation. The identification of the corals at Long Falls as Devonian makes it more than probable that the corresponding rock at Anderson Falls is of the same age. The 5 feet of rock above the Waldron again remain of uncertain age.

According to barometrical measurements the Clinton west of Benville lies 23 feet above the level of the railroad station at Old Vernon, or 722 feet above the sea.

The Waldron about 2 miles east of Old Vernon was 24 feet below Old Vernon railroad station, or 675 feet above sea level.

The Waldron at the Tunnel Mill was 65 feet below the Old Vernon railroad station, or 634 feet above sea level.

The Waldron at Benville was calculated as being due at 61 feet above present Clinton level, or 783 feet above the sea.

FRANKLIN COUNTY.

L. NEAR CAVE HOLLOW FALLS.

202.* About three-quarters of a mile east of the county line, and north of the road, north of the railroad, is a quarry opened in the Lower Silurian, which is worked chiefly for crushed stone. The limestone at the top of the Lower Silurian is here quite solid, and has a white color; in places it is nearly 20 inches thick. A little salmon-brown Clinton is seen.

206. Going from Larkin Walter's quarry, in Decatur County, a quarter of a mile eastward, and then a mile northward, a good exposure of Clinton is seen at a little fall, near a road corner. The Clinton is here 7 feet thick; it has a salmon-brown color, and rests on white Lower Silurian rock. The Osgood beds beneath the soapstone layer are about $8\frac{1}{2}$ feet thick. The soapstone is about 24 inches thick.

207. A third of a mile northward the Cave Hollow Falls expose a somewhat larger section.

*The numbers refer to numbered localities on the accompanying maps.

M. BUENA VISTA AND VICINITY.

208. A mile west of Buena Vista, Bull Fork, a branch of Salt Creek, is crossed by the east and west road. The Clinton is here at least three feet thick, and probably does not exceed three and one-half feet at this point. Its color is reddish or reddish-brown, but not salmon-colored.

209. A mile east of Buena Vista, and nearly three-quarters of a mile south of the county line, the Clinton is exposed in Long Branch; its color is salmon-brown, and it rests on nodular white limestone material. Beneath this is the heavy dark-blue limestone layer, which, near St. Maurice, shows the wave markings.

210. Half a mile directly eastward, in the bottom of another branch of Salt Creek the salmon-brown Clinton is seen to be about five feet thick.

212. Little Salt Creek.—Two miles north of Buena Vista the south fork of Little Salt Creek exposes at least two and one-half feet of Clinton. The Clinton contains *Rhinopora frondosa* and other characteristic fossils, but its color is not salmon-brown, the usual color of the Clinton in this part of the State. The Clinton rock is bluish; similar to some coarser grained Lower Silurian rocks.

211. Two and a half miles east of Buena Vista, where the road turns northeastward, a small branch of Little Salt Creek exposes a little salmon-brown Clinton.

N. BULL TOWN.

213. Senior's Quarry.—South of Bull Town, two miles southeast of Andersonville, and four miles west of Laurel. The quarry is found on the western side of Little Salt Creek, along a small tributary stream, an eighth of a mile south of the collection of houses known as Bull Town. At the quarry only the Laurel formation is exposed, but farther down the stream the Osgood formation is seen. The Osgood beds are again exposed on the eastern banks of the creek opposite the entrance of the stream. The Clinton and the upper part of the Lower Silurian are found just beneath. The measurements of the Clinton in the following section were taken from the creek locality.

Stripping.	{ 5 feet.	
	{ 4 inch layer.	
	{ 4 inch layer.	
	{ 4 inches, much chert.	
	{ 3 inch layer.	Of no account, commercially.
	{ 8 inch layer.	
	{ 2½ inch layer.	
	{ 5 inches with chert.	
Laurel Limestone.	{ 4½ inch layer.	The best layers of quarry rock.
	{ 7 inches. Spotted calc.	
	{ 5 inch curbing.	
	{ 2 inch flagging.	
	{ 8 inch curbing.	
	{ 1 inch layer.	
	{ 6 inch curbing.	
	{ 3 inch layer.	Not worth much.
Lower Quarry or Osgood Rock	{ 7 inch layer.	
	{ Clay bed, not exposed, about 1½ feet thick.	
	{ 7½ to 8 feet of limestone, poor quality.	
Clinton Limestone.	{ 3 feet 2 inches thick; salmon-brown above, more pink or light-red below.	
Lower Silurian.	{ Blue clay of the type known as cement rock at the Derbyshire falls; 8 feet thick, with very even and fine grain.	

In the Clinton were found *Orthis calligramma* and *Heliolites sub-tubulatus*.

214. Bull Town Locality.—At Bull Town where the State road crosses Little Salt Creek, the Clinton is exposed in the creek bed north of the bridge. The Clinton contains a few pebbles of a greenish clayey, fine-grained rock, resembling, lithologically, some of the rock known as cement rock in the neighborhood of Laurel. The cement rock occurs in the upper part of the Lower Silurian, but stone of a similar character occurs also as layers and lenses in the Clinton itself in this neighborhood; making it probable that the material for the pebbles was derived from the Clinton layers rather than the Lower Silurian. The largest pebbles were three to four inches long. Quarries of Laurel limestone rock occur farther up, for half a mile on both sides of the stream.

O. COAL PIT HOLLOW AND DERBYSHIRE FALLS.

215. William Senior's Locality.—Along the Coal Pit Hollow, three miles in a direct line west of south of Laurel, is an exposure at the head of a little valley, entering the Hollow just before reaching the road connecting the hollow with the State road. The Clinton is here 60 inches thick. It is salmon brown above and lighter red below. The fossils are: *Illæmus ambiguus*, *Orthis calligramma*, *Orthis* (*Platystrophia*) *biforata*, *Strophomena* (*Strophonella*) *patenta*, *Strophomena* (*Orthothetes*) *hanoverensis*, *Rhinopora verrucosa* and *Pachydictya bifurcata*. Below the Clinton are two inches of white limestone belonging to the Lower Silurian. Rock of this character often occupies this position in Ripley and Jennings counties. Beneath this limestone are Lower Silurian limestones with abundant fossils.

216. Half a mile northward, near the head of Hall's Hollow, are located several quarries. Here are the most southern quarries opened in the Laurel formation in the vicinity of Laurel, Indiana.

217. Lower Derbyshire Falls.—Located at the head of a short gully a short distance northeast of the Derbyshire Falls. The Laurel limestone was formerly quarried at this point. The following is the section exposed here:

<i>Stripping.</i>	{	2 feet.	
		4 inch gutter flag, street crossing and paving stone.	
		2½ inch layer, flag.	
		6 inch layer.	
		6 inch spotted calf layer, with chert; street crossing.	
<i>Laurel Limestone.</i>	{	4 inch curbing.	} Chiefly used for 5 inch curbing after dressing.
		6 inch curbing.	
		6 inch curbing.	
		6 inch curbing.	
		3 inch curbing.	
		6 inch curbing.	
<i>Top of Osgood Beds</i>	}	6 inch curbing.	

218. Derbyshire Falls.—Located at the head of a gulch formed by a stream, three miles southwest of Laurel, in a direct line, and nearly two miles west of the river. At this location is found the lower continuation of the section last described, as follows:

Limestone bed at base of Laurel beds.

Blue clay.

Lower Quarry or Osgood rock, 7 feet 6 to 9 inches, total.

Doubtful horizon: White Clinton or base of Niagara rock; 1 foot 3 inches.

Clinton; 7 feet 6 inches; reddish.



DERBYSHIRE FALLS, FRANKLIN COUNTY, IND.

The top of the Lower Silurian is very argillaceous; from the base of the Clinton to the pool at the foot of the falls is a vertical height of 32 feet. The total height of the falls is about 40 feet.

219. About three-quarters of a mile down the valley from Derbyshire Falls, a deep valley enters from the north. At the angle made by these valleys, high up on the cliff, the Clinton is well exposed. Beneath the Lower Quarry or Osgood beds is a rather fine-grained, crinoidal rock, whose position is doubtful. It is one foot six inches in thickness. The Clinton is five feet three inches thick. Its color is red or reddish brown, and the limestone contains layers and lenses of argillaceous rock.

P. BRANCHES OF LITTLE SAIN'S CREEK.

220. Chris. Mead's Quarry.—Located two and a half miles southwest of Laurel, on the Little Sain's Creek road, and then half a mile southward up a branch of the creek. The Clinton is exposed a little distance beyond the junction of two small branches of the stream. It is six feet six inches thick; the upper part is salmon-brown in color, the lower is reddish. The fossils observed are: *Illænus daytonensis*, *Calymene vogdesi*, *Plectambonites transversalis*, var. *elegantula*, *Strophomena* (*Orthothetes*) *hanoverensis*, *Leptaena rhomboidalis*, *Atrypa marginalis*, var. *multistriata*, *Orthis calligramma*, the form found at Hanover, *Clathropora frondosa*, *Pachydictya rudis*, *Hemitrypa ulrichi*, *Phylloporina angulata*, *Heliolites subtubulatus*, *Favosites venustus*, *F. favosus*, *Halysites catenulatus*, *Cyathophyllum daytonense*.

The Lower Quarry rock was exposed, but its thickness was not measured. Judging by the neighboring exposures, it does not exceed six feet six inches.

The lower part of the Laurel bed is quarried northeast of the Clinton exposure. Beginning with the base of the formation, the following layers are found: Six inches and then three inches of poor, soft rock, known locally as the underground ledges. Good quarry stone as follows: Five, four, six, four, five, six, two and four inches; the spotted calf layers, formed by a six-inch layer, followed by two inches of chert and six inches of limestone; then less valuable rock, used chiefly for flagging, as follows: Four, three, three, five, five, five, two and two inches of chert; two, two, three and one inch of chert; three, two, three and four inches of chert, and six feet of stripping.

Immediately below the Clinton is blue shaly clay, with typical loose Cincinnati group fossils within several inches of the Clinton.

221. D. L. Secrist's Lower Quarry.—Located a quarter of a mile

north of Chris. Mead's quarry, at the head of another gully, is an old, abandoned quarry formerly worked by D. L. Secrist. It lies south of the southern branch of the Little Sain's Creek road. The upper salmon-brown portion of the Clinton is exposed at the lowest point in the quarry.

Overlying the Clinton is the Lower Quarry or Osgood rock, which here is six feet six inches thick. In general it is a bluish rock, occurring in rather massive layers, which, however, go to pieces rather readily under the influences of weathering. It is a very argillaceous limestone, containing at various levels considerable crinoidal material, which gives it a lithological appearance very much like that presented by the Osgood beds at the New Point quarries. Measured from below upwards, the following section is presented: Four inches of drab-colored limestone, considerably resembling the basal Niagara of more southern sections; 26 inches of stone which often come out together, but which usually separate into the following layers: Ten, three, three, three, three and five inches; twenty inches of rock, which usually separate into nine and ten-inch layers; fifteen-inch, six-inch and seven-inch layers; the latter forming the top of the Osgood section.

Above the Osgood bed is a twenty-inch layer of blue clay, which is the very characteristic parting between the Osgood bed and the Laurel limestone of these regions, and which is known as the soapstone ledge farther southward. It lies near the top of the Osgood beds.

222. Harrison Crowell's Quarry.—Two and a half miles southwest of Laurel, just before reaching a fork of the Little Sain's Creek road, a branch enters the creek from the south. Nearly a mile up this branch, just east of the township line, is the quarry of Harrison Crowell. The Clinton is exposed a short distance down stream. Over it lies the Lower Quarry, a part of the Osgood rock; its thickness is 11 feet 6 inches; it is not quarried. A bed of blue clay or soapstone is seen near the top of the Osgood bed, above the Lower Quarry rock. The base of the Laurel limestone is locally known as the underground ledge; it is a bluish stone, of variable quality, so that it is sometimes quarried for curbing, and sometimes considered as inferior stone. At the Crowell quarry it is quarried; it consists of several layers, in ascending order: Seven, six and two and one-half inches thick. The succeeding layers, five, five, two, four, six, two and six inches thick, form the best curbing stone of the quarry. They underlie the spotted calf layer, which shows the usual chert nodules; it is formed by three, three and one-half and two-inch layers, the middle portion composed chiefly of chert. The overlying courses are interbedded too often with chert to be a very valuable part of the quarry, and any rock found

available in this section is considered so much clear gain by the quarrymen. The following gives the thickness of the courses in ascending order: Four inches with chert nodules, two layers three and four inches thick, often clinging together; two inches of chert, three inches of limestone with chert nodules; three, three, two, two and two inches of limestone, the last layer with chert. The layers above the spotted calf are used chiefly for flagging. The stripping over the rock amounts to about three feet.

223. A short distance down stream, on its southern side, the Clinton is 34 inches thick. The upper part has a salmon-brown color, the lower part is reddish. The lower part of the Clinton contains rounded fragments of *Heliolites*, of brownish, fine-grained siliceous Clinton rock, and of a greenish rock which very much resembles the upper part of the Lower Silurian rock just beneath the Clinton, where it is hard and very argillaceous. Rock of this kind, however, occasionally occurs interbedded with the normal Clinton in some places, so that the origin of these pebbles can not be conclusively determined. The following fossils were found in the Clinton: *Orthis calligramma* with many plications, *Heliolites subtubulatus*, *Halysites catenulatus*, *Cyathophyllum daytonense*, and *Ptychophyllum ipomea*, several specimens.

Below the Clinton are four to five inches of solid dark-blue rock, underlaid by soft greenish clay.

224. An eighth of a mile down stream from Crowell's quarry, near a quarry on the south side of the stream, at the head of a little gully the Clinton is exposed. It is three feet six to ten inches thick, has a salmon-brown color above, and is reddish below. The basal Niagara, with its drab color, directly overlies it.

225. Harry Manly's Quarry.—About half a mile east of the township line, on the northern side of Little Sain's Creek, is Harry Manly's quarry. A good detailed section of the rock was obtained at this point, which is given here in descending order.

Stripping. { 12 feet of clay and a little rock.

Laurel Limestone.	{	5 inch cheap yellow flagging or curbing.	{	Chiefly used for rubble and lower grade stone work in general.
		2 inch stone.		
		2½ inches of chert.		
		3 inch stone.		
		4 inch stone.		
	{	3½ inch stone.	{	
		3½ inch layer, with chert nodules in lower part.		
		6 inch layer, with chert nodules in upper part.		
		4½ inch, good flag or curbing.		
		4½ inch spotted calf layer, with chert nodules in upper part, used for ditch stone and gutter flag.		

<i>Laurel Limestone, Continued.</i>	{ 3 inch flagging.	
	{ 6 inch curbing.	
	{ 2 to 2½ inch light cellar flag.	
	{ 8 inch layer, used for 6 inch curbing.	
<i>Lower Quarry Rock or Osgood Bed.</i>	{ 7 to 9 inch layer used for curbing and steps or sills.	
	{ 7 to 9 inch layer used for curbing and steps or sills.	
	{ 1 foot of soft blue clay, locally known as soapstone.	
	{ 14 inches.	
	{ 22 inches, capping into 3 layers	
	{ These layers though thicker are never quarried.	
	{ 3 feet 6 inches of thin layers of soft limestone, not quarried.	
<i>Clinton Limestone.</i>	{ 3 feet 8 inches of limestone, salmon brown above, reddish below.	
<i>Top of Lower Silurian Rock.</i>	{ 4 feet of soft blue clayey material, with a hard, 6 inch layer, 6 inches below the Clinton.	

226. A. W. Cloud's Quarry.—Located about half a mile northwest of Manly's quarry, at the head waters of Little Sain's Creek, just east of the township line. The following detailed section describes the rocks in descending order:

<i>Stripping.</i>	{ 4 feet of clay and rock.	
	{ 7 inches for street crossings, foundation footings and gutters.	
	{ 2 inches.	
	{ 6 inches.	
	{ 3 inches.	
	{ 3 inches.	
	{ 3½ inches.	
	{ 2½ inches of chert.	
	{ 4 inches, for flagging and street crossings.	
	{ 2½ inches.	
	{ 2½ inches, cherty.	
	{ 3½ inches, cherty.	
	{ 4½ inches.	
	{ 4½ to 5 inches, for crossings and gutters.	
	{ 5 inches with chert.	
	{ 7 inches.	
	{ 2 inches of chert.	
<i>Laurel Limestone.</i>	{ 4 inches, street crossings and gutters.	
	{ 5 inches, street crossings and gutters.	
	{ 4 inches, street crossings and gutters.	
	{ 5 inches.	
	{ 5 inches.	
	{ 5 inches.	

Not useful except for crushed stone.

Sometimes grown together, used for street crossings.

Sometimes holding together, used for street crossings.

Sometimes holding together, used for foundations for heavy buildings.

Too hard for curbing.

Often holding together; spotted calc; used for 2 crossing stones or 1 foundation stone.

<i>Laurel Limestone, Continued.</i>	{	5 inches; first cut ledge, for curbing.	}	Often holding together, used for steps, water tables, building stone and heavy curbing.	}	"Underground" courses.
		3 inches; ragged layer, for gutter stone.				
		4 inches.				
		6 inches.				
		2 inches, for grave covers and light flagging.				
		6 inches, for curbing and gutter.				
		8 inches.				
		4 inches.				
<i>Osgood Beds</i>	{	5 inches, for curbing.	}	used for curbing.	}	
		1 foot of soft blue clay, locally known as soapstone.				

The Lower Quarry or the rest of the Osgood stone bed is exposed farther down stream.

227. A. W. Cloud's Old Quarry.—Directly north of the quarry last described, across a low ridge, is another quarry, also worked by A. W. Cloud, but only to a small extent. It is situated at the head of a northern branch of Little Sain's Creek. The quarry is opened in the Laurel limestone.

228. D. L. Secrist's Quarry.—A short distance east of the last quarry is one of Secrist's quarries. The Laurel stone here exposed is more brown than usual. The following section is here exposed:

<i>Stripping.</i>	{	4 feet.	
<i>Laurel Limestone.</i>	{	2 inches of chert.	} For flagging.
		3 inches.	
		4 inches.	
		5 inches.	
		3½ inches.	
		3½ inches.	
		3 inches.	
		4 inches.	
		3 inches.	
	{	6 inches; spotted calf layer.	Street crossings.
		2½ inches.	} Flagging.
		2½ inches; ragged layer.	
		8 to 10 inch; for stairs; sometimes splitting up into 6 and 4 inch layers, then used for curbing.	} Used for highest grade curbing.
		3½ inches.	
		4 inches; bottom ledge.	
{	4 inches.	} Underground courses, used for lower grade curbing.	
	6 inches.		
	5½ to 6 inches.		
	Soft blue clay, not measured.		
<i>Osgood Beds</i>	{	Lower Quarry or the rest of the Osgood beds; not measured, but about 6.5 thick.	
<i>Clinton Limestone.</i>	{	30 to 36 inches thick.	

The Clinton is not well exposed; it occurs in the bed of the stream about 100 feet west of the quarry. The fossils were *Clathropora frondosa* and *Halysites catenulatus*.

229. About a quarter of a mile down stream, on the southern side of the stream, the Clinton is 40 inches thick.

230. D. L. Secrist's Quarry.—About two and one-half miles southwest of Laurel, the Little Sain's Creek road forks; a short distance east of the fork is a stone schoolhouse. From this point a road leads up to a quarry on the very summit of the ridge north of the creek. This is another of D. L. Secrist's quarries. The following is a section of the rock here exposed:

Laurel Limestone.	Stripping.	{ 7 to 10 feet.
		{ 6 inch layer, brown.
		{ 6 inch layer, brown.
		{ 3 inches of chert.
		{ 3 inches of chert.
		{ 8 inches, gutter culvert covering stone.
		{ 6 inches, with a little chert; gutter and street crossing stone.
		{ 7 inches; spotted calf layer; with a little chert.
		{ 5½ inches; curbing.
		{ 3 inch flag.
		{ 6 inch curbing.
		{ 4 inch curbing.
		{ 2 inch flagging.
		{ 5 inch curbing.
		{ 5 inch curbing. } Often together, requiring capping.
		{ 8 inch curbing.
		{ 6 inch curbing. } The "Underground" layers.
		{ 7 inch curbing.
		{ 20 inches of soft blue clay.
Osgood Beds	{	Lower Quarry or the rest of the Osgood beds; 4 feet 6 inches, total.
Clinton Limestone.	{	25 inches of salmon brown stone.

Q. DRY BRANCH.

231. Dry Branch Quarry.—Located south of the road two miles northwest of Laurel. The Clinton is here 11 inches thick. It is bluish in color, with salmon-brown crinoidal spots intermingled, varying in places to a general salmon-brown tinge, not as marked, however, as in the case of the more southern exposures. In places it has a light-red tinge spotted with salmon-brown specks. The fossils are:

Orthis calligramma, the form found at Hanover; *Orthis elegantula*, *Pachydictya bifurcata*, *P. obesa*, *P. turgida*, *Rhinopora verrucosa*, *Heliolites subtubulatus*, *Favosites favosus*, *F. niagarensis*, *Halsites catenulatus*, *Cyathophyllum celator* var. *daytonense*, and a large specimen of *Ptychophyllum ipomea*.

Overlying the Clinton are five feet six inches of the Lower Quarry or Osgood rock. It consists mostly of thin layers of drab or light-brown limestone, traversed by many vertical seams, so that it is not quarried. The lowest layer is quite hard, lies directly on the Clinton, and resembles the basal Niagara of more southern sections. The Laurel bed consists of bluish limestone. The first marked chert layer occurs five and one-half feet above the base of the Laurel bed; it is the spotted calf of this region. The layers below this chert bed are the layers of Laurel rock chiefly quarried. Above the spotted calf layer the Laurel section contains chert layers at distances of six to ten inches apart, for a thickness of about five feet.

Below the Clinton is a bed of blue clay twenty inches thick. Beneath is a four-inch layer of limestone; its color is blue, varying towards brown; sometimes it has a salmon-brown color, which is confusingly like the Clinton in lithological appearance, although containing the usual Lower Silurian fossils: *Rafinesquina alternata*, and *Orthis* (*Hebertella*) *occidentalis*. Below this are six feet of soft blue clay, with some thin limestone layers, twenty feet of blue limestone, with many fossils and interbedded with clay layers, and four feet of blue clayey shale.

232. Reiboldt's Cave or Falls.—Half a mile south of the Dry Branch quarry, on the west side of the branch, a side stream enters from the Reiboldt farm. A short distance up this stream is a fall formed by the projecting Clinton rock; the Lower Silurian clayey rock immediately below has been washed away so as to leave quite a cave beneath the Clinton, whence the name. The Clinton is seven feet two inches thick; its color is salmon-brown above and light red or pink below. About one foot of soft blue clay overlies the Clinton. The drab basal Niagara immediately above forms the base of the Lower Quarry rock of this region.

Below the Clinton are five feet of Lower Silurian blue clay; eight feet of fossiliferous limestone, two feet of blue clay, four feet of fossiliferous limestone, and two feet of blue clay, perhaps only in small part exposed.

Halsites catenulatus was found in the Clinton.

R. BIG SAIN'S CREEK AND BRANCHES.

233. John Deis' Locality.—Half a mile southwest of Reiboldt's Cave is the house of John Deis. Northwest of the house, immediately west of the road, the Clinton is 32 inches thick; its color is reddish or pink, not salmon-brown. It contains *Favosites niagarensis*, *F. venustus*, and *Cyathophyllum daytonense*. Below the Clinton are four inches of Lower Silurian blue limestone, with *Orthis* (*Hebertella*) *occidentalis*.

A short distance northwestward a small stream exposes the Clinton again; it is here only 22 inches thick.

234. Immediately south of the house only 12 to 16 inches of the Clinton are exposed, although the total thickness of the Clinton at this point may be somewhat greater.

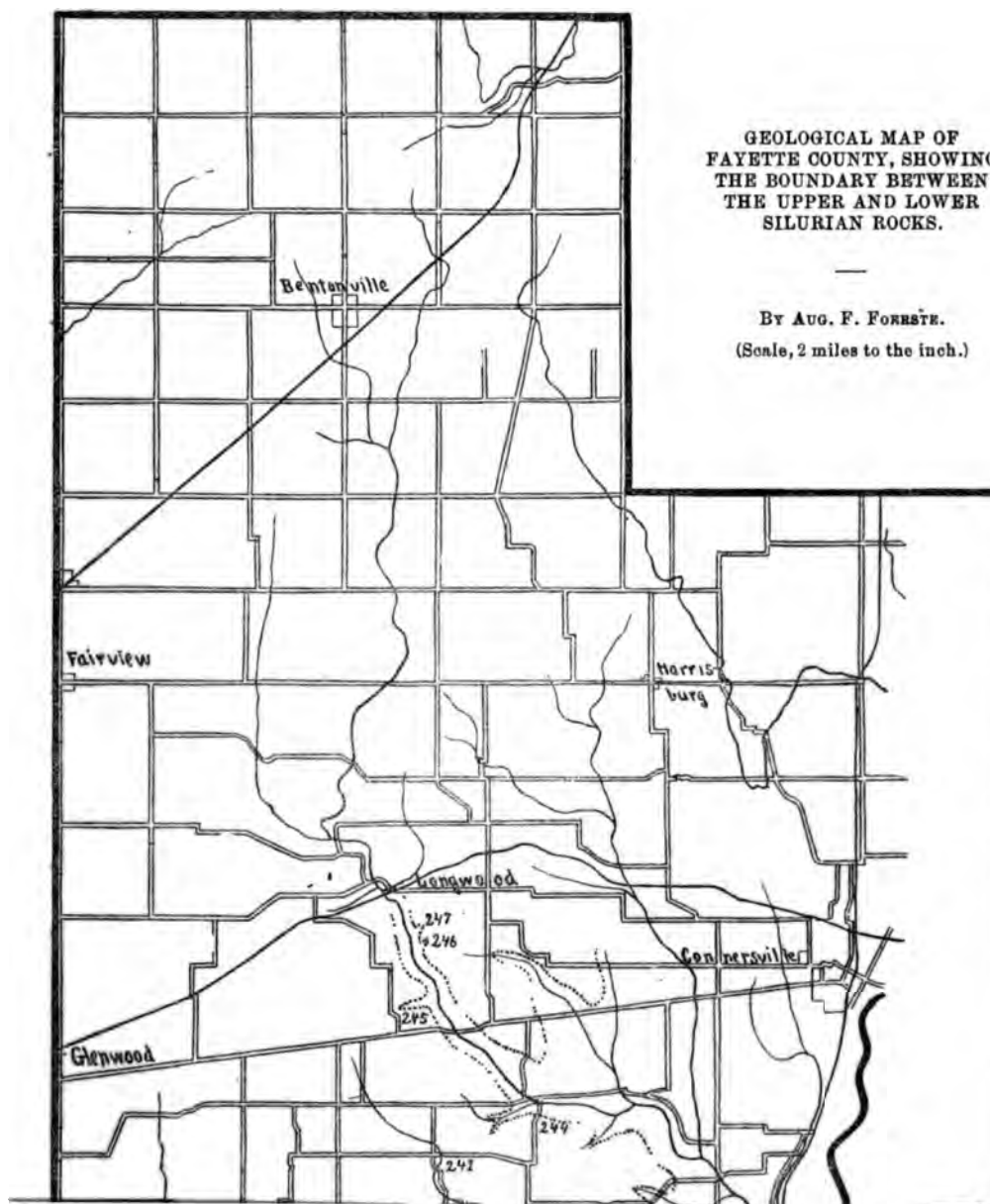
235. John Bower Locality.—The stream west of Deis' house flows southward and empties into Big Sain's Creek. Half a mile up the creek, a short distance below John Bower's house, on the north side of the creek, near the head of a gully, is an exposure of the Clinton, four feet four inches thick. Its color is between salmon brown and reddish, and it is strongly crinoidal.

A hundred feet farther southward the Clinton is only three feet thick. The upper ten inches are of a good salmon-brown color; the middle and lower parts are fine-grained, not crinoidal; the color is reddish brown; characteristic Clinton fossils are common.

236. Daly Adams' Quarry.—Two miles up the creek, about four miles west of Laurel, on the north side of the creek, just before reaching the next north and south road, is the quarry of Daly Adams. The Clinton is here four feet four inches thick; its color is salmon brown. The Lower Quarry or Osgood rock is ten feet six inches thick, and is composed of thick layers, which are not quarried. At least four feet of the Laurel bed are quarried.

The upper part of the Lower Silurian is formed by quite solid argillaceous rock, about two feet thick, underlaid by about twelve feet of blue shaly clay, and this in turn by several feet of hard but thin argillaceous limestone.

237. Half a mile farther up stream, just south of the county line, on the east side of the creek, the Clinton is 52 inches thick. Its color is reddish brown; it is a siliceous limestone, quite different from the Clinton most typical of the Laurel region. Below the Clinton are four feet of hard blue clay.



FAYETTE COUNTY.

S. SOUTHERN PART OF THE COUNTY.

238. Big Sain's Creek Locality.—About five miles northwest of Laurel, in Franklin County, the road reaches Big Sain's Creek, a short distance south of the county line. At this point the road turns northward and skirts the eastern bank of the creek for half a mile northward. Exposures of the Clinton are rather common as far north as the church. It is 34 inches thick and has a reddish color. It is fine-grained where siliceous, and coarsely crinoidal where distinctly red and not siliceous. Lithologically the Huston quarry Clinton is intermediate between this rock and the Clinton as exposed southwest and west of Laurel. At the present locality the Clinton includes pebbles, lenses and layers of a bluish, more fine-grained rock. The pebbles are therefore derived from rock of Clinton age.

239. J. N. Huston's Quarry.—About two miles northwest of Laurel, in Franklin County, the road crosses Dry Branch; from this point a road passes northward into Fayette County. A quarter of a mile north of the county line, where the road begins to descend the hill, a quarry is seen in the fields west of the road, quite a distance from the same. The Laurel formation is here quarried. The Clinton is exposed at the lower end of the quarry, in the former bed of a small stream. It is four feet six inches thick; its color is intermediate between salmon brown and a bluish-brown color, specked with small reddish-brown spots.

About a mile north of Locality 238, just east of the township line, on the road going northeastward along the little creek is Thomas's quarry, the last quarry opened in the Laurel limestone within reasonable distance of the Laurel area.

T. FAYETTE TO COLUMBIA AND NORTHWARD.

240. Two miles southeast of Fayette, along the northern side of the creek, about twelve inches of pinkish Clinton are exposed. The total thickness may be considerably greater.

241. A mile northeastward and over two miles directly eastward of Fayette a better exposure is seen. The top of the Lower Silurian is composed of blue shaly clay, and at least nine feet are exposed above the bed of the creek. The solid Clinton limestone is 20 inches thick. Its color is chiefly reddish, but salmon-colored tinges are recognized

here and there. Near the top it contains a few streaks of bluish clay. Directly over the more solid Clinton is found an alternating series of thin limestone and blue clay layers having a total thickness of 18 inches. Although quite unlike the usual appearance of the Clinton elsewhere, these layers are undoubtedly to be classed with the Clinton, and suggest that its total thickness is here about three feet. At Locality 240 these upper layers of the Clinton were probably also present, but were not seen.

243. A mile and a half north of Columbia, Lower Silurian fragments occurred in the gravel of the creek bottom.

242. A mile up stream from Locality 243 the lower Laurel limestone is exposed. The limestone layers are here quite thin, similar to those at Longwood. The Clinton level must lie somewhere between localities 242 and 243.

U. VICINITY OF LONGWOOD.

244. Three miles directly north of Columbia is found the lower portion of the creek which causes the exposures near Longwood. Lower Silurian strata could be detected even in the highest exposures on the hillsides south of the creek.

245. At Ochiltree's quarry, over a mile south of Longwood, on the road west of the creek, the Clinton can not be readily distinguished from the associated rocks, although its general position can be readily determined. The thickness of the Clinton has been recently determined with considerable exactness at the Longwood quarries, and no doubt it is practically the same at Ochiltree's quarry.

The Laurel limestone is quarried here at present to a moderate extent, but more than at all the quarries at Longwood.

246. Ball's Quarry.—At Longwood, five and a half miles west of Connersville, is Ball's quarry, located a quarter of a mile below the railroad crossing, on the eastern side of the stream, at the head of a short gully. The Clinton is here four feet thick; its color is reddish-brown; the stone is rather fine-grained for Clinton rock, and is a quite siliceous limestone. It is very difficult to distinguish in some places from the immediately overlying Niagara limestone. The fossils recognized are: *Orthis flabellites*, *Leptæna rhomboidalis*, an obese form of *Atrypa marginalis*, *Phylloporina angulata*, *Pachydietya rudis*, *Rhinopora verrucosa*, *Heliolites subtrabulatus*, *Striatopora flexuosa* and *Halysites catenulatus*. Immediately above the Clinton, at the quarry, is found a six-inch bed of soft blue clay; this bed is not seen at some of the exposures farther north. Above the clay are six feet of brownish limestone which are not quarried. This represents the Osgood

bed of Ripley County, or the Lower Quarry rock of the Laurel region. The lower layers of this bed are rather thick, but they are traversed by numerous seams which destroy their value as a quarry rock. The upper layers are thinner, not exceeding four inches in thickness; but they are also discarded by the quarrymen. The fossils seen came from the lower layers of the Osgood bed, and consisted of a species of *Orthoceras* and *Atrypa reticularis*.

The layers which are quarried are assigned to the Laurel horizon. Measuring from the lower layers upward, the following courses are found (all the measurements are in inches): Four, two, poor; four, one, one and one-half, two and one-half, three, two and one-half, one, poor; three, one and one-half, two and one-half; four inches of limestone, including numerous chert nodules, probably the equivalent of the spotted calf layer of the Laurel section; two and one-half, poor; two, poor; one and one-half, one and one-half, one and one-half, one and one-half, one, one and one-half, one; four inches of cherty limestone, one and one-half, three inches. It will be noticed that most of the layers are very thin. The surface is very uneven, and evidently was formed in rippling water. The rock is suitable chiefly for flagging and rubble. Some flags of considerable dimensions have been removed from the quarry.

Below the Clinton are the upper layers of the Lower Silurian. In descending order the following is the section exposed: Forty-five inches of blue argillaceous rock, softening to blue clay, with a four-inch layer of hard rock near the middle; five inches of blue limestone weathered to rusty brown; 24 inches unknown; 28 inches of limestone and argillaceous rock interbedded; six inches of blue argillaceous rock with worm borings; 10 inches of bluish-brown limestone; 44 inches of hard blue clay, breaking up in irregular masses; 60 inches of rock, more like brown argillaceous rock above, but a hard limestone below; five inches of hard reddish-brown limestone, with abundant chert material included; 43 inches of argillaceous and siliceous limestone, of brown color.

247. On a former visit to this region, one of the more northern openings along the eastern side of the stream was better exposed; the rock most quarried was evidently that part of the Laurel bed below the spotted calf. It is there accredited as being four feet thick and probably included a part here included in the Lower Quarry rock. The spotted calf chert bed was two inches thick; above this lay 15 inches of good flagging stone, three of chert, 13 of rock, one of chert, and 12 of rock; followed by a mass of loose chert, evidently the accumulation of several layers, the intermediate limestones having been disintegrated.

REPORT OF THE STATE NATURAL GAS SUPERVISOR.

LETTER OF TRANSMITTAL.

OFFICE OF THE NATURAL GAS SUPERVISOR, }
KOKOMO, IND., Jan. 25, 1898. }

PROF. W. S. BLATCHLEY,

State Geologist :

Sir—I transmit herewith to you my third annual report. It is made in obedience to section 7,504 of the Revised Statutes of the State of Indiana, and is for the year ending December 31, 1897. It is the sixth annual report from this department.

It is due for me to say at this time that during the past year I have had frequent occasion to ask your aid and counsel, and for the same I beg to tender my grateful acknowledgment.

Yours respectfully,

J. C. LEACH,

State Natural Gas Supervisor.

differently in the various localities of the gas field; sometimes successfully and sometimes not. A careful study of these questions and prompt action always does some good, and frequently prolongs the life of the well for many months, or even years. Being guided by observation in the field and experience, I have tried to make this report along the lines indicated above as practical as possible, endeavoring to answer those questions most frequently asked, and to give such advice and such recommendations as will, in my judgment, do most to preserve the present supply of this valuable fuel. The chapters on the "Condition of the Field," found in the successive annual reports from this department, are a history of the field from its beginning, and for the reason, with others stated above, that a majority of the people interested in the natural gas industry care more for present condition than "theories," first consideration is given to the former in this report.

MAP OF THE GAS FIELD.

The map of the Indiana Natural Gas Field accompanying this report will, it is thought, be a valuable aid to those who are studying the field. The original gas area is shown, and by the pipe lines and wells both the developed and undeveloped territory can be located. Owing to the limited space only about 17 per cent. of the wells are marked. The principal pipe lines, not service lines, are located. The general direction of the pipe lines are given, the frequent angles found in some being omitted. The location of tributary pipe lines are not shown.

OIL FIELD.

The oil industry has been very active during the past year, and while a report on this subject is not included in the duties of this department, because of its close relation to the gas industry in some sections of the field, the location of oil territory is shown on the map, and reference is made to the subject in its appropriate connection.

STATISTICAL INFORMATION.

The statistical information specified by the law authorizing reports from this department, has been very fully given in former reports, and in the reports of the State Geologist and Bureau of Statistics. They are not repeated here.



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ACKNOWLEDGMENTS.

In performing the work of this office during the past year gas companies, manufacturers, farmers and drillers have rendered me much assistance, without which my work would have been much more arduous and less effective. To all these and others who have aided me, I desire to return my grateful acknowledgments.

THE INDIANA NATURAL GAS FIELD.

A BRIEF REFERENCE TO ITS HISTORY AND DEVELOPMENT, AND ITS PRESENT CONDITION.

Natural gas was found in Trenton limestone, near Portland, Indiana, March 14, 1886. This was the beginning of an era of exploration, the most important result of which was the location of the Indiana natural gas field. The first well was small compared with the average since drilled in this field. The eastern edge only of the gas rock had been penetrated. The second well was drilled at Eaton, Delaware County, the following September, and the third at Kokomo, Howard County, in October of the same year. Though the well at Kokomo was as near the western edge of the field as was the well at Portland the eastern edge, it was much more productive, discharging at least 3,000,000 cubic feet of gas daily for four years. This well, with others in that territory, succumbed to the invasion of the salt water before the rock pressure of the field showed a material decrease. The well at Eaton produced more gas daily and for a longer period than either of the above wells. Kokomo is sixty-two miles west of Portland. Eaton is eight miles south of a straight line connecting Portland and Kokomo. The drilling of numerous wells between these two points soon demonstrated that the territory intervening was gas-producing. Incited by the nearly universal success of the drill in this region, companies were organized in almost every county in the State, and the drill started on its mission of exploration.

At that time but little was known of the formation in which the gas is stored, nor was more known of the origin of this hydrocarbon. The relation that the textural and structural conditions of a rock, in

which the lighter hydrocarbons are stored, bears to the production of the same had not been considered by the local geologists. The great value of natural gas as a heat-producing power and the fact that the first wells indicated a very large if not an inexhaustible supply of it, were incentives sufficient to develop the field, and finally to locate its boundaries. However convenient and valuable the new fuel was thought to be, but few, if any, imagined the great change to be wrought in this section of the State within the next decade on its account.

Natural gas had been found in Trenton limestone, a universal formation in this State. Was it a universal gas-producing rock? If not, why not? Answers to these questions were reserved for the future. All theories had to conform to the story of the drill.

The Trenton limestone in this State is a reservoir for natural gas over a limited area only. From Portland west to Kokomo; from Greensburg, Decatur County, north to LaFontaine, Wabash County, an area of about 2,500 square miles. It must not be understood that this entire area is gas-producing at present, for nearly, if not quite, one-half of it has been practically abandoned; has been overrun with salt water. Outside of the original gas area the Trenton limestone is, with a few exceptions, barren, while within, with similar exceptions, it is the most productive gas rock in the United States.

As would be expected, there were many failures in the search for gas in the State of Indiana and an immense expenditure of money, but the "gas belt" was located and in addition the large number of deep wells drilled in the various sections of the State revealed the character and condition of the underlying strata; increased the knowledge of geology of the State and the popular respect for the same.

Now that it was possible to obtain definite knowledge of the geological structure of the State, scientists soon began to investigate the conditions that controlled the origin, accumulation, etc., of natural gas and oil, and the result was that reasonable theories accounting for the same were presented, discussed and accepted by the leading geologists of the country. Nothing has been added to these conclusions recently. Time confirms their truthfulness. A discussion of the subject, or even a statement of the commonly accepted theories regarding the same, would simply be a reiteration of what has been said in former reports from this department. However, it may be said that the data obtained by scientific investigation or practical observation did not warrant the conclusion that natural gas would last forever, but quite the reverse.

The geologists of the State were the first to warn the people of the gas belt against the vandal-like waste that was so often seen during the early history of the field, and I am sorry to say can be seen in some localities yet. But little attention was given to the subject at that time, and the statements made that the supply of natural gas was limited, was being diminished each day by the amount of gas used and wasted, were labeled as idle assertions, made in the interest of gas companies. The difference of opinion on the subject is not so marked now as it was in the past, nor are the commonly accepted views based on theories. The evidence is present everywhere in the field that the supply of this valuable fuel is being rapidly exhausted.

The people of Indiana knew of the value, as a heating power, of natural gas even before they knew that within the borders of their own State was the largest, as well as most productive gas area of the world. They knew of the Pennsylvania and Ohio fields. They had heard of the wonderful growth of Findlay and other towns in Ohio; how they had grown from villages to cities in a short time; how small agricultural towns had been transformed into thriving manufacturing cities. This was the kind of prosperity the Indiana towns hoped to see. As we shall see hereafter they began to advertise their fuel resources and other advantages far and wide. To many this was not in vain. Small country villages soon became prosperous manufacturing towns, with the conveniences of cities, and the large cities can boast of twice their former population. The gas belt is the manufacturing center of the State. The discovery and utilization of natural gas as a fuel has caused this almost miraculous change within the last ten years. When the supply of natural gas is exhausted other changes will be necessary. There is little doubt but that, in most instances, other fuels will be successfully used.

It is certain that the time will come when the supply of natural gas will not be sufficient for manufacturing purposes, and it is equally true that a large per cent. of the factories in this section located on account of its fuel privileges. I am glad to know that the indications are that the gas belt will remain the manufacturing center of the State after the natural gas supply has been exhausted. A majority of the factories using gas are substantially built and are doing a prosperous business. They are advantageously located with regard to the great jobbing centers and transportation facilities to the same. Referring to the condition of the manufacturing industries in the gas field, I quote from my last annual report:*

*Twenty-first Annual Report of the Department of Geology and Natural Resources, Indiana. 1906.

"While a change of fuel will be necessary in the future, and no person knows this better than the manufacturers, there is no cause for immediate alarm. Manufacturers know and appreciate the value of natural gas, and are providing for the future as far as possible. The larger factories, located near cities where the field shows signs of exhaustion, have pipe lines and sufficient territory to protect their interests. Others located where the consumption for other purpose is light, are drawing from wells in the vicinity of the factory, two hundred feet of pipe in some instances being sufficient. True, a majority of the first wells drilled show signs of exhaustion, but in many cases the territory is only partially developed, and the new wells are usually productive. Any signs of a shortage in the fuel supply causes much anxiety regarding its future on the part of the manufacturers, and this is usually followed by more care and economy in its use.

"Further inquiry shows that other fuels can be used without serious inconvenience to supplement the supply of gas where it fails to come to the full requirement of the manufacturing plants.

"Of course, the chief reason for the location of factories in this section of the State during the last nine years are the advantages possessed by this fuel, but evidence is present that the proximity to the markets of the country and the splendid railroad facilities possessed were considered, and, while it is true that some manufacturers who have outlived a less productive gas field are apprehensive concerning the future, they are disposed to find another fuel, if it is necessary, rather than a new location. Taking into consideration the present condition of the field, the proximity to the Indiana coal field and its railroad connection with the gas field, it seems that a majority of the industries of the Indiana gas belt are permanently located."

The conditions have changed but little since the above was written. The draught upon the field for manufacturing purposes has been extraordinarily light for the past two years. A few factories have been compelled to change their plan for fuel supply, and in a very few instances, factories located near the edge of the field or in localities remote from pipe lines, have either changed to other fuel or are supplementing their supply of gas with wood or coal. It is reasonable to suppose that this will continue where necessary in the future. I do not know of a single instance where a factory has left the gas belt on account of the fuel item.

It is in the progress and present condition of the natural gas industry that we are most interested. We have been enjoying its use, both as a manufacturing and domestic fuel, since 1886. In the light of the past history of the field and its present condition, how long will

it continue? Is this gaseous fuel being generated as we use it, or is there a fixed stock, upon which we are drawing? I will leave the first question until the condition of the field is given. The other question need hardly be mentioned at this late day. While it is probably true that natural gas is being generated daily, and will so continue as long as material out of which it may be, is in the earth's crust, it is equally true that the amount generated daily is not more than a small percent. of the amount wasted under ordinary conditions. Practically the stock of natural gas is complete, and every cubic foot either consumed or wasted, reduces the supply by that amount, and brings us that much nearer to the time when the supply will cease to honor the draught that is being made upon it from day to day.

When the gas field was located and the boundary of the gas-producing area established, it was not known that the Trenton limestone was a productive rock over the entire field, until wells were drilled in every town and hamlet and every township over the entire area. The wells drilled for exploring purposes were quite sufficient to supply the domestic consumption the first year of the history of the field.

At first but few people knew how to control or use the new fuel. From the larger cities and towns committees were sent to the older fields to investigate safety appliances and methods of consumption.

Gas companies in the smaller towns and country took advantage of the information thus obtained, and it was a very short time after the discovery of gas until it was possible for every resident within the confines of the field to use gas for fuel and light. While, as I have said, the people in the gas belt soon became acquainted with methods of consumption, I am sorry to say that but few have learned how to use this fuel as economically as its value warrants, nor is it probable that much attention will ever be given to this very important phase of the subject as long as gas is sold by the "contract system."

Doubtless natural gas is most valuable as a domestic fuel, yet this fact does not attract from its value as a manufacturing fuel, as a heat-producing power. Manufacturers were not slow to learn this, and were soon investigating the new field. The advantages that a city and the surrounding country would derive from large manufacturing industries were apparent. Many factories were anxious to locate in the gas belt, and to secure these a sharp competition arose between the cities and towns seeking to locate them. Most of the towns offered subsidies in the shape of land, free fuel or cash subscriptions. While inducements in the way of cash to cover the expense of moving a manufacturing plant, or land for building purposes may be proper, nothing can be said in favor of giving "free gas," as

was done in many instances. The result is invariably a lack of business-like economy in its use. I am confident that if free gas had never been included in the subsidies offered manufacturing establishments, and if they had been compelled to pay a reasonable price for their fuel, that its value would have been appreciated more highly, and as a consequence an economy commensurate with this would have been practiced. "Free fuel" has been used too freely in most instances for the highest good of the natural gas industry.

NATURAL GAS AND OIL.

Natural gas and oil are usually referred to as associated products of the earth's crust. They unquestionably have the same general history, and the fact that their origin and the conditions under which they are stored are practically the same, are sufficient reasons for this. Then, with all the facts in mind regarding the origin and nature of these hydrocarbons, it is not unreasonable to search for both in the same locality, though the idea that "oil follows gas," as is so frequently stated, is erroneous. That has not been the history of gas and oil fields in other States, nor has it been found true in this State. Reference will be made to this subject in another section of this report, and it is only mentioned here incidentally to show the apparent reason for the presence in this field of oil operators soon after its discovery.

It was not long after it became known that Indiana contained a large and productive gas field until large tracts of land were leased for both gas and oil, and a few test wells drilled. So far as I know nothing was found to encourage further development for oil. The territory leased was in the heart of a productive gas field, and it seems true that it was with these oil operators in possession of large tracts of gas territory, that the pipe-line idea in this State originated. The organization of a company to construct a pipe line from the Indiana gas field to Chicago stimulated the Indiana towns near the field to investigate the subject. The result is known. Indianapolis, Crawfordsville, Lebanon, Frankfort, Lafayette, Logansport, Peru, Wabash, Huntington, Bluffton, Ft. Wayne, Decatur, Union City, Richmond, Connersville, Shelbyville, Chicago and western Ohio are connected with the most productive portion of the field, each by one or more pipe lines. Prior to the construction of these lines no systematic drilling had been done. It was not necessary for factories to go outside of their own yard, or cities beyond their limits for fuel. A few wells were drilled in the country, and "farmer lines" could be found

along the principal highways. With the pipe lines came a more systematic and complete development of the territory. The various lines entered the field at the nearest point and have been extending toward the center of the field from year to year. A uniform extension of the principal pipe lines would find the center of the field between Fairmount, Grant County, and the northwest corner of Delaware County. With the exception of the Indianapolis lines, but slight extensions toward the center of the field have been made this year. Wells have been drilled mainly to supply lateral extensions. An examination of the map accompanying this report will give the reader accurate information regarding the location of the various pipe lines, pumping stations, etc.

The territory occupied by the various pipe lines at present is practically "drilled out." The drilling of any considerable number of wells in the future will involve main-line extensions.

For a number of years cities were supplied with fuel for both domestic and manufacturing purposes from wells within their corporate limits. While this is true yet in a few instances, it will soon be a thing of the past. Pipe lines are becoming a necessity. As a rule the larger manufacturing institutions maintain their own independent pipe lines, while the smaller factories are supplied by gas companies. The map indicates cities and towns in the field that pipe gas for any considerable distance for either domestic or manufacturing purposes, also those that obtain gas from the immediate vicinity. Of the larger towns, Elwood, Alexandria and Hartford City are still depending largely on the first wells drilled for their fuel supply. While the wells at these places remain productive, their closed pressure has decreased uniformly with the field.

At present there are about 250 square miles of territory that has not been invaded by pipe lines. In this section, which includes parts of Grant, Madison and Delaware counties, enough wells have been drilled to supply the local consumption only.

I am often questioned as to the miles of pipe line in the State. If by pipe line is meant all gas pipe, regardless of size, that is used to convey gas, then the question becomes exceedingly difficult to answer. If, however, by pipe line is meant the larger lines, those usually termed pipe lines by gas companies, then a fairly accurate estimate can be made. Taking into consideration all lines four inches and over in diameter, there are near 1,300 miles in the State.

While all the territory within the confines of the natural gas field, as shown on the map accompanying this report, either is at present or has been gas producing, all parts are not alike productive. With the

fact in mind that the productiveness of a gas rock is governed entirely by its structural and textural condition, the above does not seem unnatural. If the Trenton limestone is very porous and the gas passes freely from the rock to the well, thereby permitting a heavy draught without materially lowering the density of the gas in the rock, wells drilled in the same will be productive, while if there is a lack of porosity in the rock, and the gas passes through it slowly, the reverse will be true.

The structural condition of a gas rock may be such that the wells can not withstand a heavy draught, even for a short time, without inviting the salt water. In some sections of the field strong wells, with a rock pressure of over 250 pounds, have been overcome by this agent, while in other sections wells with less than 100 pounds rock pressure continue serviceable. Then, the number of wells drilled in any locality to supply a given consumption, is controlled largely by natural conditions. In one section the rock is very hard, the wells are small and a large number are necessary to supply the domestic consumption. However, it may be said that wells of small capacity, because of the uniform and close texture of the gas rock in a given locality, maintain a higher rock pressure and are longer lived than wells in more porous rock. This can be demonstrated in the extreme southern part of the field. For a detailed account of the conditions necessary for gas accumulation, as well as those present in the Indiana field, the reader is referred to the Twentieth Annual Report of the Department of Geology and Natural Resources of Indiana, 1895, pp. 383-5. That the conditions in the southern part of the field may be understood the above is briefly referred to here.

The reservoir in which the supply of natural gas in this State is stored, is a low, broad elevation or arch, the Cincinnati arch, that crosses the eastern boundary of the State between Lawrenceburg and Liberty, and extends in a northwestern direction across the State. This arch is found at a depth of 349 feet below the surface, 158 feet above sea level, where it enters the State, and 1,300 feet below the surface at Valparaiso, or 602 feet below sea level. It is found at sea level between Elwood and Kokomo. The incline to the northwest is not uniform and the surface is very uneven in some places, consisting of numerous small ridges or folds, with occasional spurs extending at various angles from the main elevation. The Cincinnati arch acts as a trap, in which the gas in this field accumulates. It is held in this gas-holder under an enormous pressure, due to the weight of a column of water back of it. The gas is prevented from escaping by a covering of Utica shale, which is impervious to water and gas, and forms a perfect cover for the Trenton limestone.

"Wherever the Trenton limestone is a gas or oil rock, it is always substantially a pure dolomite, highly crystalline and of a sufficient porosity to contain large quantities of these hydrocarbons. Its storage capacity is much greater than that of sandstones. Outside of the gas area the conditions are different. There the limestone is nearly pure and non-porous. The dolomitic change has not taken place. From the above it is plain that the porosity of the Trenton limestone is due to its chemical composition, or at least connected with it. In the oil and gas area this limestone has been transformed in its upper beds; the carbonate of lime giving way in part to carbonate of magnesia."*

With what has been said regarding the geological structure of the gas field and the general limitations surrounding the same in mind, a specific mention of the general condition of the various sections of the field will be better understood.

THE CONDITION OF THE FIELD.

The southern extremity of the Indiana natural gas field is in Decatur County. But little gas has been found south of Greensburg. The productive portion of the Trenton limestone in this county is very thin, varying from five to ten feet thick. It is very hard and lacks the porosity found in the northern part of the field. The gas passes very slowly from the rock to the well, and consequently the wells are very small, the average not supplying over twenty families with domestic fuel. With all this, the indications are that the gas supply will last longer here than in the more productive parts of the field. The texture of the rock nearly precludes the possibility of overworking the wells. Salt water is not present to a dangerous extent, and it seems almost incredible, nevertheless it is true, that the rock pressure in this section at this late day is 300 pounds. That part of Decatur County, north and west of Greensburg is gas-producing. The territory in the vicinity of St. Paul and the southwestern part of Rush County are similar to the territory just mentioned, except that the rock pressure decreases toward the north. Nine miles northwest of Rushville it is 255 pounds. About one-half of Rush County is gas territory. The northwest part of the county in the vicinity of Carthage has to combat the influence of the salt water more than the territory farther south, and consequently has a lower rock pressure.

*Twentieth Annual Report of the Department of Geology and Natural Resources, Indiana, p. 383.

That part of the original gas area in Shelby County is producing but little gas at present. All of Hancock County, except the southwest part, is in the gas field. While it is not as productive as some portions of the field, many good wells have been drilled. The rock pressure varies from 150 to 200 pounds, owing to the age and condition of the well. Greenfield and Shelbyville are supplied from this county. Every section of Henry County has been tested for natural gas. A number of failures have been recorded in the southeast part of the county. The west half of the county is most productive. Knightstown has an ample supply of gas from territory six miles northwest of the city. Shirley, on the boundary between Hancock and Henry counties, has some good wells, and the territory in the northwest part of the county is still producing some gas, though the salt water is very intrusive.

But a small area in the northwest part of Wayne County has produced any gas, and it is practically exhausted. Though the northern part of Marion County has been thoroughly tested for gas, not enough has been found to place the county in the gas field. A few wells drilled at Broad Ripple during the past year are producing some gas. Hamilton County, with the exception of a small area in the southwest corner, is gas territory. This county claimed some monster wells during the early history of the field. The three pipe lines from Indianapolis pass through the eastern part of this county, and have drawn heavily upon its gas resources. At present the salt water is very troublesome, and the rock pressure of the eastern half of the county is not above 190 pounds.

Crawfordsville and Lebanon are being supplied from territory north and east of Sheridan. The rock pressure there is higher than in the eastern part of the county.

All of Tipton County, except a small area in the northwest corner, is in the gas field. Early in the history of the field a few test wells drilled at Tipton, the county seat, were failures, from what cause it is not known; for in 1896 a well showing a rock pressure of 270 pounds and a daily capacity of 1,500,000 cubic feet was drilled one-half mile east of the city. The Lafayette and Frankfort pipe lines pass through this county, and until recently were supplied from its territory. That part of the county west of Tipton is practically exhausted. The rock pressure of the eastern part of the county is not above 210 pounds.

Randolph County west of Winchester is in the original gas field. The east one-half of this area has been abandoned. Wells in the vicinity of Parker show oil. The best wells show a closed pressure of 190 pounds. The western part of Jay County has proven to be a

valuable gas field. Though the wells drilled in the vicinity of Portland have long since been abandoned, wells in the extreme western part of the county, with a rock pressure of 125 pounds, are still producing gas in valuable quantities. The wells in the vicinity of Dunkirk show a rock pressure of 195 pounds.

Of a number of test wells drilled in Wabash County a few in the vicinity of LaFontaine produce gas in small quantities. The wells in Miami County, with a few exceptions in the vicinity of Converse, have been abandoned.

The eastern part of Howard County, though on the edge of the field, contains much valuable gas territory. Kokomo was one of the first, if not the first, city in the gas belt to use the new fuel. Nearly every well drilled in the vicinity of Kokomo was a "gusher." The structure of the rock is such, however, that the salt water soon overrun the territory, and now this city is piping gas from the eastern part of the county, a distance of twelve miles. The rock pressure in this part of the field is 210 pounds.

For convenience, Grant, Madison, Blackford and Delaware counties will be considered together. They are all in the original and present gas-producing area, except a narrow strip of territory along the northern edge of Grant and Blackford counties. The principal pipe lines draw largely from these counties, and Grant, Madison and Delaware contain the only territory in the field not threaded by pipe lines.* Southeastern Grant, northeastern Madison and northwestern Delaware County have not been touched by pipe lines, and have had only enough wells drilled to supply the local consumption and thoroughly test the territory. This territory is certainly the "heart" of the field. It contains about 250 square miles. Its average rock pressure is 215 pounds. This is a decrease of 30 pounds during the past year. The average rock pressure of the four counties under consideration, not considering the territory in the vicinity of Alexandria, is not far from 200 pounds.

In the vicinity of Alexandria the decrease in both the rock pressure and volume of flow of wells has been greater than in any other part of the field. This is attributed to the heavy draught upon this section by the oil industry.

In speaking of the condition of a field I have referred to the rock pressure only, for the reason that it is the popular way of indicating its productiveness, many believing that accordingly as this is high or low, so is the productiveness of the field great or small. This in a

* See map accompanying this Report.

great measure is a mistake. While a decrease in the rock pressure indicates a general diminution in the supply of the field, it does not indicate the volume of flow when applied to a particular well, or the permanence of its supply. Wells in a given territory registering the same rock pressure, usually vary in capacity. A well with a rock pressure of 210 pounds shows a daily capacity of 4,000,000 cubic feet, while another on the same farm, showing the same rock pressure, will only flow 1,000,000 cubic feet daily, or less. The reasons for this are found in the difference in the draught on certain areas, and in the texture of the rock. When a well is closed it becomes a part of the main reservoir, and if all the wells in the field should be closed, each in a short time would show the same rock pressure; the normal pressure of the field. That is to say, the gas in each well would register the maximum rock pressure of the field, because the gas in the wells would be of the same density as the gas in the rock. The time required to obtain this varies in different localities. Where the gas rock is very porous, permitting the gas to pass through it freely into the well, the maximum rock pressure is reached quickly when the well is closed. When the well is open into the line, the density of the gas in the well does not show a marked change, and the volume of flow is large. If the conditions are changed a change in the result will follow. That is to say, if there is a lack of porosity in the rock, the gas thereby passing through it slowly, the capacity of the well will be small, and when the well is closed, the gas will reach its maximum density slowly, though finally showing the normal rock pressure of the field. Then, on account of the difference in the porosity of the rock, one well may produce but little gas, and another in the same locality be of greater capacity; yet whether large or small, they will, if closed, eventually reach the same rock pressure. This may require days, for, on account of the small difference in the pressure of different sections of the field, it equalizes slowly. A well that will produce 6,000,000 cubic feet of gas in twenty-four hours shows no greater rock pressure than one that produces only 500,000 cubic feet, though the first reaches its maximum rock pressure in a few seconds, while the latter may require hours. Rock pressure does not indicate the productiveness of a field.

Referring to this subject, Prof. Edward Orton says:* "The rock pressure of gas may perhaps be continued with little abatement of force until the end of the production of a field is near. The maintenance of pressure is no proof whatever of the maintenance of the

* Eighth Annual Report of the United States Geological Survey, 1899, p. 596.

supply. The last 1,000 feet of gas come out from the gas-holder with as much force as the first 1,000. In a field that contains both gas and oil, but in which the reservoirs of these is differentiated, the first sign of approaching failure will be the invasion of either level by the contents of the division next below."

GAS WELLS.

Generally speaking, the condition of a gas field must be judged by the condition of the wells. They are an index to the field, provided they have received proper care. It is a mistake to turn wells into a line and give them no further attention until a shortage of gas renders it necessary. Gas companies and owners of gas wells are fast learning this. The care should begin when the well is being drilled. First, none but experienced and responsible drillers should be employed. The location of the salt water horizon should be ascertained and the drill stopped before it is reached. Usually a small gas well is more valuable to a gas company than a large salt-water well. When the well is finished care should be exercised in tubing and packing. Only tubing perfect in every detail and not larger than is necessary, should be used. It is much easier to properly pack a well at first, even if the tubing has to be drawn and the packer reset, than it is to repack after the well has been closed a year or more. All gates, valves, etc., should be examined frequently, that they may be in working order when it is necessary to use them. At this time in the history of the field there are but few localities in which salt water does not appear within a comparatively short time after the well is turned into the line, even if the drill has stopped above it. This must be cared for, or the well will soon be useless. If the pressure of the gas is strong enough to bring it to the surface, through the well tubing, it can be separated from the gas by means of an automatic separator. Any water that may be in the line can be caught in properly arranged drips attached to it. The latter can be constructed and connected to the line without any particular skill or much expense.

If the pressure of the gas is not strong enough to lift the water through the well tubing, then the only practical thing to do is to place a small tube, say three-fourths of an inch in diameter, to the bottom of the well. Properly arranged, a small amount of gas will lift the water through this tube, thereby cleaning the well, and the gas will pass into the line comparatively dry. The tube need not be left open all the time, but opened at intervals, as often as necessary, to relieve the well of the salt water.

Where it is not practical to use either separator referred to above, and the rock pressure is sufficient, the well should be opened often enough to allow it to relieve itself of the accumulated water. This will waste a small amount of gas, but the damage to the field will not be as great as it is when the water is allowed to accumulate until it overpowers the pressure of the gas and hermetically seals it in the rock. Ordinarily the small inner tube is altogether practical, and with it the salt water can be successfully resisted, for a time at least, and the life of the well prolonged. The pressure of the gas will raise the water in the small tube long after it fails to lift it in the larger well tubing.

As to the number of wells in the gas field, either abandoned or productive, I do not attach much importance, except for statistical purposes. To get exact figures is almost an impossible task. Some gas companies have kept accurate records of all wells drilled and a history of the same from the beginning. Based upon the most reliable data obtainable, I submit the following estimate:

First—Number of wells drilled for gas since March 14th,	
1886	5,400*
Second—Number of wells abandoned since March 14th,	
1886	2,800
Third—Number of wells producing gas January 1st, 1898.	2,600

WASTE OF NATURAL GAS.

So much is being said about the waste of natural gas at this time that a reference to the subject in this paper is hardly necessary. At most the condition, at present only, will be noticed. The extravagant use and vandal-like waste of natural gas in the past is common history. That the future of the natural gas industry depends much upon how this fuel is used from this time on; upon whether it is used economically or otherwise, no one will deny. In the past the public has given but little heed to the warnings given either from this department or other sources, regarding the magnitude of the gas waste, and the certain results of the same.

On account of some extraordinary wastes this year, the public has become aroused. I refer to the waste of gas occasioned by the efforts that are being made in high-pressure gas territory to develop an oil field. Oil has been found in many localities on the northern and eastern border of the gas area since 1886. Though the oil production

* This does not include wells in which no gas was found.

in that section has involved the waste of some gas, owing to the proximity of the two fields, the amount has been insignificant compared with the waste in the gas field. The gas from the oil wells in the vicinity of Montpelier, Van Buren, Pennville and Geneva is not sufficient for drilling and pumping purposes. Pipe lines are necessary to procure fuel to develop the oil territory.

Indications of oil have been noticed in a number of localities in the gas field since its discovery. The first attempt to develop an oil field in the "heart" of the gas field was last spring, at Alexandria. A well completed on the Nimrod Carver farm, two and one-half miles northeast of Alexandria, April 23d, proved not only to be a good oil well, but a very large gas well. The result of that "find" can not be given now. Since that time 69 wells have been drilled for oil in that section of the field. Of these, 30 produce both gas and oil, the remainder being either "dry holes" or gas wells only. The waste of gas from the beginning has been enormous; increasing, of course, with each new well. The oil operators, as a class, while pretending to be opposed to the waste of gas, have shown no disposition to save it.

The manufacturers of Alexandria and the surrounding cities became alarmed about the future of their fuel supply as soon as the first oil well was drilled, but curious as it may seem, merchants, business men, etc., of Alexandria have from the first until quite lately seemed indifferent to the waste of the product that caused their city to grow from a small village to a modern city. At one time not fewer than 25,000,000 cubic feet of this valuable fuel escaped into the air every day, and the rock pressure of the gas in the immediate vicinity of Alexandria decreased during the summer from 200 to 125 pounds, and yet the public generally seemed to think that the oil industry was an advantage to the town. It is very difficult to enforce the law under the conditions above stated. Any attempt made to enforce a law which interfered with the oil industry in the least was at once branded as an improper interference on the part of the State with the rights of the people. Soon after the oil development began at that place I filed a number of affidavits against oil-well drillers for burning large natural gas torches for drilling purposes. The first case was tried at Alexandria. The defendant did not deny burning the flambeau, claiming that it was necessary to light the derrick. The law violated by burning the flambeau had been declared constitutional by the highest court in the State but a few weeks previous, and yet a jury, composed of merchants, business men and farmers, after deliberating five minutes, brought in a verdict of "not guilty." I relate this to show the sentiment with which we have had to contend at that place.

However, I am glad to say that a change has been wrought. From some cause or other the people have become aroused to the importance of the subject and are aiding me now in every way possible to suppress the waste of natural gas. Parties who drilled for oil during the early excitement are now the most enthusiastic supporters of the law and the efforts to suppress the waste of gas.

THE NATURAL GAS LAW.

The law enacted in 1893 to prohibit the waste of gas from wells provides, in Section 1, "That it shall be unlawful for any person, firm or corporation having possession of any natural gas or oil well, whether as contractor, owner, lessee, agent or manager, to allow or permit the flow of gas or oil from any such well to escape into the open air, without being confined in such well or proper pipes or other safe receptacle for a longer period than two (2) days, next after gas or oil shall have been struck in such well. And thereafter all such gas or oil shall be safely and securely confined in such well, pipes or other safe and proper receptacles."

The penalty for the violation of this section, as specified in Section three (3) of the same Act, is as follows: "Any person or corporation violating any provision of this act shall be liable to a penalty of two hundred dollars (\$200.00) for each and every such violation, and to the further penalty of two hundred dollars (\$200.00) for each ten days during which such violation shall continue; and all such penalties shall be recoverable in a civil action or actions in the name of the State of Indiana, for the use of the county in which such wells shall be located, together with reasonable attorney's fees and cost of suit."

It also provides in Section four (4) of the same Act, that "Whenever any person or corporation in possession or control of any well in which natural gas or oil has been found shall fail to comply with the provisions of this act, any person or corporation lawfully in possession of lands, situate adjacent to or in the vicinity or neighborhood of such well, may enter upon the lands upon which such well is situate and take possession of such well from which gas or oil is allowed to escape in violation of the provision of Section 1 of this Act, and pack and tube such well and shut in and secure the flow of gas or oil, and maintain a civil action in any court of competent jurisdiction in this State against the owner, lessee, agent or manager of said well, and each of them, jointly and severally, to recover the cost and expense of such tubing and packing, together with attorney's fees and costs of suit. This shall be in addition to the penalties provided in Section three (3) of this Act."*

* See Acts 1893, p. 300.

It will be noticed that the law is not criminal, but involves the infliction of a penalty for its violation, the same being recoverable in a civil action in the name of the State of Indiana for the use of the county in which the well is located. Every violation of this law during the past year has been reported to the prosecuting attorney of the county in which the law is violated, with the necessary information for a civil complaint, which always includes the location of a well, the date when completed, the kind of a well and the estimated capacity, together with the name of its owner, lessee or manager. Information for 34 complaints have been filed since the 1st of last May. The first case to come to trial was the "State of Indiana, for the use of Madison County *vs.* The Ohio Oil Company." In this case, as in all others where the State is endeavoring to prevent the waste of natural gas or oil, it is contended by the State that gas and oil are the property of the State, and as such the State has a right to prevent their waste and control their use. In the above case, the only one that has come to trial, the State obtained judgment in the Circuit Court for the full amount asked in the complaint and attorney's fees. The case was promptly appealed to the Supreme Court of Indiana, and a decision from that tribunal is soon expected.

As to the adequacy of the present statute to prevent the waste of gas from oil wells, it is hardly necessary to speak now. If its provision can be enforced, I believe it to be an adequate remedy. With the certain infliction of a penalty of two hundred dollars (\$200.00) for the first offense, and two hundred dollars (\$200.00) for each ten days thereafter, so long as gas is allowed to escape from the well, oil operating in Indiana can not be a very profitable business. The greatest objection to the law as it now is, is that it involves the tedious delay of a civil action. This means much, when millions of feet of gas are escaping into the air daily.

I am inclined to believe that the provision for tubing and closing wells as provided in Section four (4) of the Act will never be a practical remedy. While its application would be a quick and effectual remedy, citizens dislike very much to attempt to interfere with their neighbors' business, which would doubtless in some cases invite a breach of peace and possible litigation.

The question as to whether injunctive relief can be had to stop the waste of gas is now before the Supreme Court of the State in two cases. One, the Lippincott Glass Company *vs.* the Ohio Oil Company, is an action brought in the Madison Circuit Court to enjoin the defendant, the Ohio Oil Company, from allowing natural gas to escape

into the open air from an oil well. In this case the defendant demurred to the complaint, and the court sustained the demurrer. Judgment was rendered against the plaintiff for costs.

The other case is similar to the one above, except that the plaintiff is the State of Indiana. It was brought in the same court. Three cases, then—The State of Indiana *vs.* the Ohio Oil Company, to decide the constitutionality of the "penalty law;" The Lippincott Glass Company *vs.* the Ohio Oil Company, to decide the right of an individual to enjoin persons owning gas or oil wells from permitting the flow of gas or oil from such well to escape into the open air, and a similar action brought in the name of the State of Indiana for the same purpose—are now before the Supreme Court. Briefs have been submitted in each case, and oral argument will be heard by the court the 25th of this month. Much depends upon the results of these cases. The State has, and will use, every means at her command to stop the unlawful waste of one of its most valuable resources.

The people living in eastern central Indiana and the surrounding cities have been privileged to use for the past ten years the cheapest, cleanest and most satisfactory fuel known to man. The supply is limited. Its life depends upon how it is used in the future. With these facts in mind, and the history of other fields, and the past of this field an open book, how much longer will the people living in the gas belt remain indifferent to the present extravagant use and waste of this fuel?

So great has been the waste from oil wells during the past year that other classes of waste seem comparatively insignificant. In some cases this extraordinary waste, which we hope to suppress soon, has been used as an excuse for the extravagant use and waste in other localities; while in other instances it has served to arouse gas consumers to the true situation, and the necessity for a combined exertion toward husbanding the gas supply.

I think it will be conceded that no one is more vitally interested in the future of the natural gas industry than are the manufacturers of the gas belt. Its fuel resources were the principal incentives for the location of a majority of the gas belt factories. Numerous manufacturing institutions are enjoying an unexampled prosperity on account of the small fuel expense. Considering all the conditions, we have a right to expect them to set the example and to practice all the economy possible in the use of one of the chief agents of their prosperity, and yet, in not a few instances, quite the reverse is found to be true. To charge all manufacturers with wasting gas or even using it

extravagantly would not be just, but an examination will convince any one that a majority use more for both fuel and light than is necessary.

It can not be said that manufacturers do not know and appreciate the value of gas as a heat-producing power. This extravagant use of fuel can not be charged to a lack of knowledge of conditions, except, probably, in a very few instances, but to a number of causes. As I have said before, the "free gas" idea that was held before manufacturers so long has had a bad influence. The seeming abundance at the point of consumption, the heavy draught that some wells have honored for years, and the small cost of the same, if not free, is responsible in no small degree for the prodigality in the use of gas in some localities. To refer to the mistakes in the past, however, is of little use, unless the future is profited thereby.

One of the chief avenues of waste in the factories of the gas belt is the lighting system in general use. Most of the factories are lighted with natural gas, and the burner used in many instances is simply the open end of a small pipe. Natural gas as an illuminant is not a success. It produces a very poor light, and when its value as a fuel is considered, it is expensive. That it is convenient for this purpose when used as a fuel is the most that can be said in its favor. Some of the larger manufacturing institutions have substituted electric lights for it. I realize that this is not practicable in some of the smaller factories, nor is the use of domestic lights any more so. However convenient or necessary it is to use natural gas for lighting purposes, I am quite sure that it is entirely unnecessary to allow large and wasteful torches to burn night and day, in all departments of the factory, whether operating or not. It is not always the largest burner or the one that consumes the most gas that makes the best light. Economical burners should be used and all lights turned out when not in use.

Of the many factories that I have visited the past year, but few were securing perfect combustion. In some instances the burners, mixers, etc., were so unscientific and ill-arranged that perfect combustion was not possible. Even if the apparatus for consuming natural gas is scientific in its construction and properly arranged, it needs constant care to insure the best results. Then, what the natural gas industry needs most in this line, is that all fuel consumers ascertain the true condition of the supply and its value to them and the public and apply business principles to the question.

Before leaving this subject I desire to say that there are a few manufacturers in the gas belt, and the number is increasing, that fully appreciate the value of this fuel and use it accordingly. They exercise

the same care in the use of their fuel that they do in the use of any other ingredient of their manufactured product. They would as soon waste one as the other.

The pipe lines within the gas area, including tributary and service lines, are in better condition than at any time during the history of the field. During the last two years most of the lines have been thoroughly overhauled. Pipe with the most approved joints has taken the place of the lead joint pipe that had been in service for a number of years, and where the pipe was not changed the joints have been carefully inspected, and air-tight clamps used where necessary. The repairs made have usually been of a permanent nature, and I anticipate but little trouble from pipe-line leaks in the future.

The chief trouble from this source has usually come from small lines, "farmer lines," service lines, etc. Hundreds of miles of this kind of pipe thread the "gas belt." Much of it belongs to small co-operative plants in the rural districts, and with these it is frequently very difficult to fix the responsibility for the bad condition of the lines. Natural-gas leaks along the highway are not only wasteful and dangerous to the public, but damaging to the pipe. The sulphuretted hydrogen contained in the gas is absorbed by the water and oxidized by contact with air to sulphuric acid, which readily attacks the pipe, forming sulphate of iron or copperas. The above acid attacks the pipe to such a degree that it is often eaten entirely through. These small lines have been the source of much trouble during the past, and I realize how difficult it is to keep small pipes lying on top of the ground, subject to a varying temperature, in repair. Watchfulness and prompt action is the only remedy. A number of gas companies keep men whose sole duty is to keep the lines in repair. This is advisable.

In the early history of the gas field one of the greatest avenues of waste was the hundreds of flambeaux permitted to burn throughout the gas belt night and day. There were sections of the field in which every village street, highway and farm yard were illuminated with natural gas torches. The amount of gas consumed by these lights was simply enormous. Not unfrequently was the gas allowed to burn at well pressure from the open end of a one-inch pipe; in fact, the volume of gas had to be strong enough to create a flame capable of resisting the wind and rain, or the flambeau would be of no value, and even the largest flambeau made a very unsatisfactory light. For most purposes a "jumbo" burner, enclosed in a glass globe, gives a better light, and does not consume over one-sixtieth of the gas consumed by an average flambeau. To prevent this great waste of the fuel resources of the State, the General Assembly of 1891 enacted a

law prohibiting the use of natural gas in flambeaux, and prescribing how it may be used as an illuminant.* This law encountered much opposition from the beginning. Public sentiment was so opposed to it that it was almost impossible to successfully enforce it. When an effort was made to do the same, its constitutionality was questioned.

Soon after taking charge of this department I caused a suit to be brought in Blackford County to enforce this law. In the Circuit Court the defendants entered a motion to quash the affidavit, and thereby attacked the constitutionality of the law. The court overruled the motion to quash. The case was appealed to the Supreme Court, and in a very short time afterward that Court rendered a unanimous decision holding the law constitutional and enunciating the following propositions of law:

First—Natural gas, in its original state, is wild by nature, and, like game, fish and birds, belongs to the sovereign.

Second—When lawfully brought to the service and reduced to subjection and control, it becomes the property of him who produces it.

Third—Being the property of the sovereign, the Legislature, which is the representative of the sovereign people, may prescribe such regulations as it may choose, with reference to the development and production of natural gas, or may prohibit its production at all, as it may prohibit the taking of certain game, the preservation of which it deems important to the general welfare.

Fourth—Natural gas is an explosive and poisonous substance, and as such is subject to the police control of the State, under which the Legislature may, by law, surround its use and protection with such safeguards as may be deemed necessary to insure the safety of persons and property.

Fifth—Being within the police power, both in its character as property and in its quality as a dangerous element, the Legislature and not the courts, is the exclusive judge of what restrictions are necessary and reasonable in the premises.

Sixth—The Legislature has a right not only to prohibit waste, but to determine what acts shall constitute waste of natural gas, and the determination of such question is not an usurpation of judicial power, but is properly an exercise of legislative discretion.

Seventh—The right to regulate the use of natural gas, under its police power, exists not only because of its physical characteristics, and its primary ownership, but rests on the principle that whatever affects the general welfare of the people is a subject of police supervision.

* Acts 1891, p. 55.

Eighth—Nor is the operation of the police power confined, as has been frequently contended, to questions of public morals, public safety, or the public health, and kindred subjects; but it embraces equally everything that affects the general commercial welfare of the State.

Though the violation of this law has caused but little trouble since the decision of the Supreme Court, it is but just to say that even before the courts had decided the above case a change had been wrought in the public mind. The law had begun to be looked upon with more favor.

THE FUTURE OF THE GAS BELT.

What will be the future history of the Indiana natural gas field? How long will natural gas last? These have been the regulation questions for the last five years, and doubtless will be until the history of the field is completed. There are persons at this late day who believe that the supply of natural gas will be sufficient for this generation. That so many people in the past have been, or seemed to be, at least, wholly indifferent to the way natural gas has been used, is not surprising. A very small per cent. of all the consumers of this fuel have given any thought to either the theoretical or practical phases of the natural gas question. They have been gas consumers, and that is all. Few there are, indeed, that are prepared to defend any particular theory accounting for the generation, storage and pressure of this gaseous fuel. In most localities there has been plenty of gas to date. The service during the past two years has been better than at any time previous, owing, in most cases, of course, to the improved facilities for transporting, distributing and controlling the gas. Those that know nothing about natural gas, except what they learn at the point of consumption, are ill-prepared to judge of the future, and those who have a good knowledge of the field know but little except that the supply is failing. Occasionally some one will venture to inform you how long gas will last, but usually these persons are compelled to revise their opinions from year to year, as unforeseen conditions arise. Natural gas was first used as a fuel in the Indiana field in 1886. For eleven years it has stood an enormous draught. The field did not show any material signs of exhaustion until 1890. Since that time the evidence has been accumulating. Salt water is the most aggressive enemy with which the natural gas field has to contend. It made its appearance at the edge of the field, and is advancing towards the center. Where it has completely overrun the gas territory the wells are no longer productive. The heavier the draught, the more intru-

sive is the salt water. The area in the heart of the field in which wells free from this agent can be found is comparatively small, and is decreasing in size yearly. The time when the entire field will succumb to its influence can not be far distant. Eleven years ago the rock pressure of the entire field was 325 pounds. Now the average pressure of the productive area, which is very much less than the original gas field, is less than 200 pounds. The average yearly decrease during the past three years has been 20 pounds, the decrease for the past year being near 25 pounds. And in connection with the above it is safe to say that a majority of the wells of the field will cease to be serviceable when the rock pressure reaches 100 pounds. This estimate is too low rather than too high. As the supply decreases, and the price advances, the consumption will naturally become lighter. Factories will use gas only where it is absolutely necessary, and supplement with other fuel; and, finally, when natural gas is used only for domestic purposes, those that can afford it will use it for a considerable time after it has ceased to be a manufacturing fuel, or even a universal domestic fuel.

A LIST OF NATURAL GAS COMPANIES IN INDIANA JAN. 1, 1898.

ALLEN COUNTY.

Ft. Wayne Natural Gas Co., Ft. Wayne.

BLACKFORD COUNTY.

Bally Natural Gas Co., Hartford City.
Citizens' Natural Gas Co., Montpelier.
E. C. Storms Natural Gas Co., Roll.
Hartford City Natural Gas and Oil Co., Hartford City.
Linbark Gas and Oil Co., Dunkirk.
Marion Creek Natural Gas Co., Priam.
Millgrove Natural Gas Co., Millgrove.
Montpelier Natural Gas, Oil and Mining Co., Montpelier.
Peck Natural Gas Co., Hartford City.
People's Natural Gas Co., Hartford City.
Trenton Natural Gas Co., Priam.
Walnut Street Natural Gas Co., Hartford City.

CLINTON COUNTY.

Indiana Natural and Illuminating Gas Co., Indianapolis.
Terhune and Kirkland Natural Gas Co., Kirkland.

DECATUR COUNTY.

Citizens' Gas Co., Greensburg.
Consumers' Natural Gas Co., St. Paul.
Fourth Ward Natural Gas Co., Greensburg.
Greensburg Natural Gas, Oil and Water Co., Greensburg.
Hamilton Natural Gas Co., Greensburg.
Muddy Fork Natural Gas Co., Greensburg.
St. Paul Oil, Gas and Water Co., St. Paul.
Newton Natural Gas Co., Greensburg.

DELAWARE COUNTY.

Buck Creek Natural Gas Co., Muncie.
Cammack Natural Gas and Mining Co., Cammack.
Compromise Natural Gas Co., New Burlington.
Cleveland Gas Co., DeSoto.
Co-operative Gas, Light and Fuel Co., Yorktown.
Co-operative Fuel and Gas Light Co., Gaston.
Co-operative Natural Gas Co., Daleville.
Cowan Exploring and Gas Co., Cowan.
Delaware Natural Gas and Mining Co., Albany.
DeSoto Natural Gas and Mining Co., DeSoto.
Eaton Mining and Gas Co., Eaton.
Farmers' Natural Gas and Petroleum Oil Co., Yorktown.
Farmers' Natural Gas and Oil Co., Albany.
Granville Citizens' Natural Gas Co., Granville.
Gaston Gas and Mining Co., Gaston.
Manufacturers' Fuel Gas Co., Muncie.
Manufacturers' Natural Gas Co., Muncie.
Muncie Natural Gas Co., Muncie.
Niles Natural Gas Co., Dunkirk.
Oakville Natural Gas Co., Oakville.
Reed Station Natural Gas Co., Reed Station.
Ross & Fullheart Gas Co., Muncie.
Royerton Natural Gas Co., Royerton.
Selma Natural Gas Co., Selma.
Mutual Natural Gas Co., Gaston.
Walker Natural Gas and Oil Co., Gilman.
Yorktown Natural Gas and Oil Co., Yorktown.

FAYETTE COUNTY.

Connersville Natural Gas Co., Connersville.

GRANT COUNTY.

Arcana Gas Co., Arcana.
Barren Creek Gas Co., Fairmount.
Citizens' Gas Co., Gas City.
Citizens' Gas Co., Fairmount.
Citizens' Gas Co., Swayzee.

Citizens' Gas Co., Marion.
Deer Creek Mining Co., Hackleman.
Fairmount Mining Co., Fairmount.
Fowler Gas Co., Fowler.
Haw Run Gas Co., Roseburg.
Herbst Natural Gas and Mining Co., Herbst.
Jadden Gas Co., Jadden.
Jonesboro Mining Co., Jonesboro.
Lake Branch Mining Co., Upland.
Landessville Gas Co., Landessville.
Mississinewa Mining Co., Marion.
New Cumberland Mining and Gas Co., New Cumberland.
Pipe Creek Natural Gas Co., Roseburg.
Roseburg Natural Gas Co., Roseburg.
Swayzee Mining Co., Swayzee.
Triumph Gas Co., Fairmount.
Sweetser Natural Gas Co., Sweetser.
Upland Mining Co., Upland.

HANCOCK COUNTY.

California Natural Gas Co., Maxwell.
Citizens' Natural Gas Co., Greenfield.
Cushman Natural Gas Co., Fortville.
Don's Natural Gas Co., Fortville.
Farmers' Natural Gas Co., McCordsville.
Fortville Natural Gas Co., Fortville.
Gilboa Natural Gas Co., Cleveland.
Greenfield Natural Gas Co., Greenfield.
Independence Natural Gas Co., Greenfield.
McCordsville Natural Gas Co., McCordsville.
Mohawk Natural Gas Co., Mohawk.
Scrabletown Natural Gas Co., Wilkinson.
Vernon Natural Gas Co., Fortville.
Westland Natural Gas Co., Westland.
Wilkinson Natural Gas Co., Wilkinson.
Willow Branch Natural Gas Co., Willow Branch.

HAMILTON COUNTY.

Atlanta Natural Gas Co., Atlanta.
Bethlehem Natural Gas and Oil Co., Cicero.
Big Springs Natural Gas Co., Big Springs.
Buffalo Corner Natural Gas Co., Arcadia.
Carmel Natural Gas Co., Carmel.
Central Gas Co., Westfield.
Cicero Natural Gas Co., Cicero.
Citizens' Natural Gas Co., Atlanta.
Citizens' Natural Gas and Oil Co., Jolietville.
Clarksville Natural Gas Co., Clarksville.
Fall Creek Township Natural Gas Co., Fisher's Switch.
Hortonville Natural Gas Co., Hortonville.

Keck Natural Gas Co., Omega.
Noblesville Natural Gas and Improvement Co., Noblesville.
Nora Natural Gas Co., Nora.
Ollo Natural Gas and Oil Co., Ollo.
Stony Creek Natural Gas Co., Noblesville.
Strawtown Natural Gas Co., Strawtown.
Westfield Gas and Milling Co., Westfield.

HENRY COUNTY.

Cadiz Natural Gas Co., Cadiz.
Central Natural Gas Co., Cadiz.
Citizens' Natural Gas Co., Knightstown.
Citizens' Natural Gas Co., Middletown.
Enterprise Natural Gas Co., New Castle.
Farmers' Free Gas Co., Mt. Summit.
Farmers' Natural Gas Co., Middletown.
Farmers' Natural Gas Co., Spiceland.
Gronendyke Natural Gas Co., Middletown.
Honey Creek Natural Gas Co., Honey Creek.
Kennard Natural Gas Co., Kennard.
Knightstown Natural Gas Co., Knightstown.
Mechanicsburg Natural Gas Co., Mechanicsburg.
Montgomery Creek Natural Gas Co., Greensboro.
Moreland Natural Gas Co., Moreland.
Ogden Natural Gas Co., Ogden.
Spiceland Natural Gas Co., Spiceland.
Sulphur Springs Natural Gas Co., Sulphur Springs.
Welcome Natural Gas Co., Knightstown.

HOWARD COUNTY.

Flabby Natural Gas Co., Plevna.
Greentown Natural Gas Co., Greentown.
Howard Natural Gas, Oil, Mining and Pipe Line Co., Sycamore.
Jerome Natural Gas Co., Jerome.
Kokomo Natural Gas and Oil Co., Kokomo.
J. M. Leach Natural Gas Co., Kokomo.
Liberty Natural Gas Co., Plevna.
Manufacturers' Pipe Line Co., Kokomo.
Pittsburg Plate Glass Co., Kokomo.
Sycamore Natural Gas Co., Sycamore.

HUNTINGTON COUNTY.

Huntington Light and Fuel Co., Huntington.
Warren Natural Gas Co., Warren.

JAY COUNTY.

Citizens' Natural Gas and Oil Co., Portland.
Dunkirk Natural Gas and Oil Co., Dunkirk.
Pennville Natural Gas and Oil Co., Pennville.

Portland Natural Gas and Oil Co., Portland.
Red Key Natural Gas and Oil Co., Red Key.
Richmond Natural Gas and Oil Co., Red Key.

MADISON COUNTY.

Alexandria Mining and Exploring Co., Alexandria.
Alfont Natural Gas and Oil Co., Alfont.
Bear Creek Natural Gas Co., Perkinsville.
Citizens' Natural Gas Co., Anderson.
Citizens' Natural Gas and Mining Co., Elwood.
Citizens' Natural Gas Co., Summitville.
County Line Natural Gas and Oil Co., Ingalls.
Dyar's Creek Gas and Oil Co., Lapel.
Elwood Natural Gas and Oil Co., Elwood.
Fall Creek Natural Gas Co., Hamilton.
Farmers' Mutual Gas Co., Summitville.
Foster's Branch Natural Gas Co., Hamilton.
Green Township Natural Gas Co., Hamilton.
Gilman Natural Gas Co., Gilman.
Hardman Natural Gas and Oil Co., Markelville.
Lapel Natural Gas and Oil Co., Lapel.
Markelville Natural Gas and Oil Co., Markelville.
Mendon Natural Gas and Oil Co., Mendon.
Perkinsville Natural Gas and Oil Co., Perkinsville.
Pendleton Natural Gas Co., Pendleton.
Summitville Mining Co., Summitville.
Victory Natural Gas and Oil Co., Summitville.

MARION COUNTY.

Consumers' Gas Trust Co., Indianapolis.
Indianapolis Natural Gas Co., Indianapolis.
Manufacturers' Natural Gas Co., Indianapolis.
United States Encaustic Tile Co., Indianapolis.

MIAMI COUNTY.

North Grove Natural Gas Co., Peru.
Xenia Natural Gas and Pipe Line Co., Converse.

RANDOLPH COUNTY.

Citizens' Natural Gas Co., Parker.
Eastern Indiana Natural Gas and Oil Co., Union City.
Elkhorn Natural Gas Co., Farmland.
Farmland Natural Gas Co., Farmland.
Lynn Natural Gas Co., Lynn.
Parker Natural Gas Co., Parker.
Rock Oil Co., Winchester.
Windsor Natural Gas Co., Windsor.
Ridgeville Natural Gas Co., Ridgeville.

RUSH COUNTY.

Big Four Natural Gas Co., Carthage.
Carthage Natural Gas Co., Carthage.
Citizens' Natural Gas Co., Manilla.
Farmers' Natural Gas Co., Mays.
Five Points Natural Gas Co., Sexton.
Hackleman Natural Gas Co., Mays.
Homer Natural Gas Co., Homer.
Manilla Natural Gas Co., Manilla.
Milroy Natural Gas Co., Milroy.
Peoples' Natural Gas Co., Rushville.
Riverside Natural Gas Co., Rushville.
Rushville Natural Gas Co., Rushville.
Rushville Fuel Co., Rushville.
Walnut Ridge Natural Gas Co., Carthage.
Walker Natural Gas Co., Carthage.

SHELBY COUNTY.

Citizens' Natural Gas Co., Shelbyville.
Fountaintown Natural Gas Co., Fountaintown.
Morristown Natural Gas Co., Morristown.
Southern Indiana Natural Gas Co., Shelbyville.
Waldron Natural Gas Co., Waldron.

TIPPECANOE COUNTY.

Lafayette Natural Gas Co., Lafayette.

TIPTON COUNTY.

Citizens' Natural Gas Co., Tipton.
Citizens' Natural Gas Co., Windfall.
Lutz Natural Gas Co., Goldsmith.
Tipton Line and Improvement Co., Tipton.
Tipton Light, Heat and Power Co., Tipton.
Windfall Natural Gas, Oil and Mining Co., Windfall.

WABASH COUNTY.

Lafontaine Natural Gas and Oil Co., Lafontaine.
Somerset Natural Gas and Oil Co., Wabash.

WAYNE COUNTY.

Hagerstown Natural Gas Co., Hagerstown.
Richmond Natural Gas Co., Richmond.

MISCELLANEOUS.

Central Contract and Finance Co., Lima, Ohio.
Indiana Natural Gas and Oil Co., Chicago, Ill.
Logansport and Wabash Valley Gas Co., Lafayette, Ind.
Ohio-Indiana Gas Co., Lima, Ohio.

REPORT OF STATE INSPECTOR OF MINES FOR 1897.

LETTER OF TRANSMITTAL.

PROF. W. S. BLATCHLEY,

State Geologist of Indiana:

I transmit herewith my third annual report as Inspector of Mines. I have endeavored to cover all the points required by law to be included therein, but it is unsatisfactory in some respects, owing to the reluctance of mine operators to furnish necessary data which can be obtained in no other way. This has compelled me to make some estimates which I can not claim to be accurate, notably the amount of capital invested, and the cost and character of improvements made during the year.

ROBERT FISHER,

Inspector of Mines.

Indianapolis, Ind., Jan. 15, 1898.

Report of Inspector of Mines

TO THE STATE GEOLOGIST.

1897.

ROBERT FISHER, Inspector.

JAMES EPPERSON, Assistant.

REPORT.

The first attempt at legislative control of coal mining in Indiana was by an act passed by the Fifty-first General Assembly, approved March 8th, 1879, though the industry had assumed considerable importance prior to that time. The first report submitted, by Herbert H. Richards, showed a total of 177 mines in 17 counties; employes, 3,459; coal produced, 1,196,490 tons of 2,000 pounds, and a capital invested of \$1,135,562. Of the mines reported, 115 employed less than ten men, leaving but 62 employing more than that number. Three hundred and eighty-eight of the 3,459 employes were employed in those small mines, and 3,071 employed in such mines as are now affected by the law in force, an average of nearly 50 men in each mine. Under the law then in force no mines were exempt from its operation. Now, the law does not apply to the mines employing less than ten men. During the year 1897 there were in operation in the State a total of 137 mines employing over ten men, with a total of 7,636 employes, and a production of 4,078,085 tons, from mines employing ten or more men.

The average production per employe in the 62 larger mines was 370.8 tons in 1879, while in 1897 the average per employe was 535 tons. The increase in average production in spite of the prolonged strike, referred to elsewhere, is to be accounted for by the increased use of powder in the mining of coal and the use of machinery for

mining and handling the coal. These points will be referred to at greater length later in this report. The facts stated above will give some idea of the development of the industry in Indiana during the past 18 years. While this has been great, we have not kept pace with our sister States in this respect. Illinois, Ohio and West Virginia have been especially active in increasing their production of coal during the past ten years, and have entered markets which were previously considered as belonging peculiarly to the Indiana fields.

From 1879 to 1891 no assistant was provided by law, the Inspector being required to do both the field and office work. This prevented him from visiting the mines as frequently as was necessary for the proper enforcement of the law. When recommendations were made or orders given for changes or improvements, his duties would not permit a return visit to learn whether or not they had been complied with, and many mine foremen took advantage of this fact to refuse to improve their mines. The Legislature in 1891 provided for the appointment of an Assistant Inspector, with a stated salary, but provided for an appropriation for expenses for both officers of only Three Hundred Dollars per year. This was totally inadequate to pay office and traveling expenses, and the result was that the Inspectors did the work that could be done with the least expense, and mines which were not convenient to visit were to a certain extent neglected. These facts account, to some extent, for the slow progress that has been made in improving the conditions of our mines, and cause us to feel like congratulating ourselves that so much advance has been made. The last General Assembly made an appropriation of One Thousand Dollars per year for the expenses of the Inspector and his assistant, which took effect on Nov. 1st, 1897. We hope to be able to do more effective work during the remainder of our term than has been done heretofore.

During the year under review our work in inspecting mines has been interrupted from a variety of causes. Feeling the necessity for the amendment of the law relating to mines in several respects, some of which have been suggested by my predecessors in every report since 1880, I spent considerable time in Indianapolis during the session of the Legislature endeavoring to secure the passage of such laws as I considered necessary, to the partial neglect of some of my other duties. I refer to this at length in another part of this report. The enactment of some of those amendments added greatly to the office work of my position, especially those requiring maps of mines to be filed, and requiring the examination of Mine Bosses, Fire Bosses and Hoisting Engineers. These laws took effect July the 15th, and nearly my whole time during the month of May was taken up with examinations

and correspondence in relation to them and to other of the amendments to the law. On July 4th a general strike of the miners of the State took place, and no systematic examination of the mines affected was possible until its conclusion, which occurred September 14th.

Since then so many mines have required examination that it has been impossible to make the number of visits necessary to assure compliance with the law where it was being violated, as prosecutions, in most cases, can be commenced only after giving notice of defects, and a reasonable time to remedy them. However, at the close of the year there are but few mines in the State which are not in fairly good condition, although those that could be passed without comment on some failure to fulfill the law are very few. Under appropriate heads, I notice Legislation, Examinations, Mine Maps, Improvements, Inspections, New Developments, Accidents, Operators and Employes, Production, and Wages, and other matters properly included in my annual report.

The following have been the Inspectors under the law:

Herbert H. Richards.....	1879—1881.
Thomas Wilson, Jr.....	1881—1885.
Thomas McQuade	1885—1889.
Thos. R. Tislow	1889—1891.
Thomas McQuade	1891—1895.
Robert Fisher	1895—

And the following have been assistants:

Welman A. Lackey.....	1891—1892.
Michael Comiskey.....	1892—1894.
Barney Martin.....	Jan. 1 to Mar. 15, 1895.
Wm. McCloud.....	Mar. 15 to Dec. 1, 1895.
James Epperson	Dec. 1, 1895—

Since the creation of the office its incumbents have been handicapped by reason of the amount of territory to be covered with the force of Inspectors, and inadequate provision for the necessary traveling and other expenses incident to the proper performance of the work to be done.

The report for 1879 notes that a ventilating fan had been placed in position by the Brazil Block Coal Company, at one of their mines, presumably the first that had been used in the State. At present there are but few mines in Indiana that depend on any other means of ventilation, as will be seen by reference to the descriptions of the different mines. This is the most efficient means that has been devised of forcing a current of air through a mine, and its use shows the progressive spirit of our operators. In this respect we compare

favorably with any other State whose reports I have examined. I am sorry to say that in many cases the underground management of mines has been entrusted to persons whose knowledge of the business is deficient, and that I am compelled to repeat a remark made by Mr. Richards. Referring to mine bosses, he says: "Many of them, having the means of good ventilation directly under their control, having a good supply of fresh air at the intake, yet leave the rooms of the workmen practically without air." While this is still true to some extent, there has been great progress in this direction, and the proportion of such mines and mine bosses is much smaller than he had to report. This refers, of course, to those that come under the observation of the Inspectors. In the small mines a great deal of the work is done on the haphazard plan of getting the most with the least present expense and letting the future care for itself. We usually find the effects of this when a mine that has been run with a small capacity increases its force of men sufficiently to bring it under our jurisdiction.

LEGISLATION.

As noted in closing my last annual report, several recommendations were made for amendments to the mining legislation of the State of Indiana. As there were but few, if any, members of the Legislature who had a practical knowledge of the working of coal mines, it became necessary for me to spend the larger part of my time, while the session continued at the Capitol, explaining the necessity of the proposed legislation, and urging favorable action upon the bills which were introduced for the better regulation of the mining industry. The committees in both Houses to whom they were referred were impressed with their importance and took prompt action upon them. All of the members of the Committee on Mines in the House and of that on Mines and Manufactures in the Senate were active in securing favorable consideration and final passage of each of them, and but for the pressure of other business at the close of the session I feel confident that each of my recommendations would have found a place upon the statutes of the State. Those recommendations were as follows:

1. Making better provision for communication between the working places of the mine and the escape ways.
2. That the Inspector of Mines shall be notified immediately when any serious accident occurs at a coal mine.
3. Providing that each mine owner shall make (or have made) a map of his mine, and furnish a copy to the Inspector of Mines.

4. Providing for the examination of Mine Bosses, Fire Bosses, and Hoisting Engineers.

5. Providing for the use of a pure oil for illuminating purposes in mines.

6. Providing for the inspection of mines employing less than ten men.

The bills prepared by this office, covering the first four of these subjects, were, after having been amended in some particulars, passed by both Houses and signed by the Governor. Copies of the acts are given below:

(Acts 1897, Page 226.)

AN ACT to amend an act entitled, "An act providing the means for securing the health and safety of persons employed in coal mines, providing penalty for the violation thereof, and repealing all laws and parts of laws in conflict therewith."

(Senate 154. Approved March 8, 1897.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That section 1 of the above entitled act, the same being section 5459 of Horner's Revised Statutes of 1896, be amended as follows:

Section 1. That it shall be unlawful for any owner, agent or operator to allow more than ten persons to work in any shaft, slope or drift at any one time after five thousand square yards have been excavated until a second outlet shall have been made. The said outlet or manway, and all approaches thereto, shall be separated from the hoisting shaft and its approaches by at least one hundred feet in width of natural strata, and shall be available at all times to all employes engaged in such mine, and that for every shaft used as a manway there shall be provided stairways at an angle of not more than sixty degrees, with landings at easy and convenient distances, and with guard rails attached to each set of stairs from the top to the bottom of the same: Provided, That, where such shaft shall be more than one hundred and fifty feet deep, the operator, owner or agent may elect to provide at such outlet or manway a hoisting apparatus, which shall be at all times available to miners and other employes of the mine, the same signals to be used as provided by law for use at hoisting shafts. The traveling roads or gangways to said outlet shall be not less than the height of the vein worked, and four feet wide, and shall be kept as free from water as the average hauling roads in such mines. All water coming from the surface or out of any strata in such shaft shall be conducted by rings, or otherwise, to be prevented from falling down the shaft so as to wet persons who are ascending or descending the shaft.

(Acts 1879, Page 168.)

AN ACT to amend sections 12, 14, 17 and 24 of an act regulating the weighing of coal, providing for the safety of employes, protecting persons and property injured, providing for the proper ventilation of mines, prohibiting boys and females from work in mines; conflicting acts repealed, and providing penalties for violation, in force June 3, 1891, the same being sections 5480M, 5480O, 5480R, 5480Y of the Revised Statutes of 1896.

(S. 195. Approved March 6, 1897.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That section fourteen (14) be and is hereby amended to read as follows:

Section 14. That whenever any accident whatsoever shall occur in any coal mine in this State which shall delay the ordinary and usual working of such mine for twenty-four consecutive hours, or shall result in such injuries to any person as to cause death or require the attendance of a physician or surgeon, it shall be the duty of the person in charge of such mine to notify the Inspector of Mines of such accident without delay, and it shall be the duty of said Inspector to investigate and ascertain the cause of such accident as soon as his official duties shall permit: Provided, That if loss of life shall occur by reason of any such accident said Inspector shall immediately, with the Coroner of the county in which such accident may have occurred, go to the scene of the accident. They shall investigate and ascertain the cause of such loss or life and have power to compel the attendance of witnesses and administer oaths or affirmation to them and the cost of such investigation shall be paid by the county in which the accident occurred, as costs of Coroner's inquests are now paid.

Sec. 2. That section 17 of said act, the same being section 5480R, of the Revised Statutes of 1896, be amended to read as follows:

Section 17. That the currents of air in mines shall be split so as to give separate currents to at least every fifty (50) persons at work, and the Mine Inspector shall have discretion to order a separate current for a smaller number of men if special conditions render it necessary. Whenever the Mine Inspector shall find men working without sufficient air, or under any unsafe condition, the Mine Inspector shall first give the owner, operator, agent or lessee a notice giving the facts and a reasonable time to rectify the same, and upon his or their failure to do so the Mine Inspector may order the men out of said mine or portion of said mine, and at once order said coal mine, or part thereof, stopped until such mine or part of mine be put in the proper condition. And the Mine Inspector shall immediately bring suit against such owner, operator, agent or lessee for failure to comply with the provisions of this section, who, upon conviction, shall be fined in any sum not exceeding one hundred dollars (\$100) for each and every day or part of day that said mine was operated.

Sec. 3. That section 24 be amended to read as follows:

Section 24. That for the violation of the provisions of any section of this act, where no special penalty is provided herein, the person or persons violating the same or any part thereof shall be held and deemed guilty of a misdemeanor, and shall, upon conviction, be fined in any sum not less than five dollars (\$5.00) nor to exceed two hundred dollars (\$200) in the discretion of the Court trying the cause.

Sec. 4. That section 12 of said act, being section 5480M of the Revised Statutes of 1896, be and the same is hereby amended to read as follows:

Section 12. That the Mining Boss shall visit and examine every working place in the mine at least every alternate day while the miners of such place are, or should be at work, and shall examine and see that each and every working place is properly secured by props and timber and that safety of the mine is assured. He shall see that a sufficient supply of props and timber are always on hand at the miners' working places.

He shall also see that all loose coal, slate and rock overhead wherein miners have to travel to and from their work are carefully secured.

Whenever such Mine Boss shall have an unsafe place reported to him he shall order and direct that the same be placed in a safe condition; and until such is done no person shall enter such unsafe place except for the purpose of making it safe. Whenever any miner working in said mine shall learn of such unsafe place he shall at once notify the Mining Boss thereof and it shall be the duty of said Mining Boss to give him, properly filled out, an acknowledgment of such notice of the following form:

I hereby acknowledge receipts of notice from of the unsafe condition of the mine as follows dated this day of, 18.....

.....Mining Boss.

The possession by the miner of such written acknowledgment shall be the proof of the receipt of such by said Boss whenever such question shall arise; and upon receipt of such notice such Mine Boss shall at once inspect such place and proceed to put the same in good and safe condition. As soon as such unsafe place has been repaired to the approval of such Boss, he shall then give permission for men to return to work therein, but no miner shall return to work therein until such repair has been made and permission given.

(Laws 1897, Page 269.)

AN ACT to compel owners of coal mines to make maps of mines, to file copies of the same with the Inspector of Mines, to make monthly reports of certain matters to said Inspector, providing a penalty for failure to comply with its provisions, and providing an office for the said Inspector.

(House 366. Approved March 8, 1897.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That within three months from the time this act takes effect the owner, operator or agent of each coal mine shall make or cause to be made, an accurate map or plan of the working of such mine on a scale of not less than one inch to one hundred feet, showing the area

mined or excavated, the arrangement of the haulage roads, air-courses, break-throughs, brattices, air-bridges and doors used in directing the air current in such mine, the location and connection with such excavation of the mine, of the lines of all adjoining lands, with the names of the owners of such land, so far as known, marked on each tract of land. Said maps shall show a complete working of the mine and, when completed, shall be certified to by the owner, agent or engineer making the survey and map, to be a true and correct working map of said mine. The owner or agent shall deposit with the Inspector of Mines a true copy of such map within thirty days after completion of the survey for the same, the date of which shall be shown on such copy, the original map and survey to be kept at the office of such mine, open for inspection of all interested persons at all reasonable times. Such map shall be corrected each year between the first day of May and the first day of September, and a new map and copy of the same shall be filed as required in the original survey, or the original map may be so amended as to show the exact workings of the mine at the date of the last survey.

Sec. 2. In case the owner, agent or operator of any coal mine shall fail or refuse to comply with the provisions of section one (1) of this act, it shall be the duty of the Inspector of Mines to appoint a competent Mining Engineer to make the survey and maps, and file and deposit them as required by said section one (1), and for his services he shall be entitled to a reasonable fee, to be paid by the party whose duty it was to make such survey and map, and shall be entitled to lien on the mine and machinery to the same extent as is now provided by law for other work and labor performed in and about the coal mines of this State.

Sec. 3. That the owner, operator or agent of every coal mine of the State shall be and is hereby required to report to the Inspector of Mines on or before the 15th day of each calendar month the name of the person in charge of such mine, the number of tons of coal produced at such mine during the preceding month, the amount of wages paid employes during such month, the amount of money expended for improvements during the said month, together with such other information as may be necessary to enable said Inspector to prepare his annual report as is now required by law.

Sec. 4. That any person who shall fail, refuse or neglect to do or perform any act or duty required by this act shall be held guilty of a misdemeanor and upon conviction shall be fined in any sum not less than five nor more than twenty-five dollars.

Sec. 5. That in order that maps, reports and other records pertaining to the office of Inspector of Mines may be properly preserved, a room in the State House shall be set aside and furnished in a suitable manner as an office for said officer.

Sec. 6. Provided, That the provisions of this act shall apply to all coal miners in this State except to those employing less than ten men.

(Acts 1897, Page 127.)

AN ACT to provide for the examination of mine bosses, fire bosses and hoisting engineers of coal mines, for issuing certificates of competency or service, prohibiting the employment of persons in either of such capacities without such certificate, and providing penalties for violation of the provisions of this act.

(S. 308. Approved March 4, 1897.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That after three months from the taking effect of this act, it shall be unlawful for any person to serve in the capacity of mine boss, fire boss or hoisting engineer at any coal mine in this State without having first received from the Inspector of Mines a certificate of service or of competency as hereinafter described and provided.

Sec. 2. That certificates of service shall be issued by the Inspector of Mines to any person who shall furnish satisfactory proof that he has been engaged as, and has successfully discharged the duties of mine boss, fire boss or hoisting engineer at coal mines in this State for three years preceding the granting of such certificate.

Sec. 3. That certificates of competency shall be issued by the Inspector of Mines to any person who shall prove satisfactorily upon examination, either written or oral, or both, as may be prescribed by such Inspector, that he is qualified by experience and technical knowledge to perform the duties of either mine boss, fire boss or hoisting engineer at the coal mines of the State. Examination for certificates of service or competency shall be public, and open to all citizens of the United States, and at least fifteen days' notice of such examination shall be given by publication in a newspaper published in the city where such examination is to be held. No certificate shall be issued to any person entitling him to serve in more than one of the capacities set out in this section, but two or more certificates may be issued to the same person on proper examination.

Sec. 4. It shall be the duty of the Inspector of Mines to hold examinations for certificates of service and competency within sixty days after this act takes effect in each of the cities of Brazil, Terre Haute, Washington and Evansville, and to publish notice of such examinations as provided in section 3 of this act, stating the time and place where examinations are to be held, and shall make and publish rules and regulations under which such examinations shall be conducted, previous to the first of such examinations.

Sec. 5. It shall be unlawful for any owner, operator or agent of any coal mine in this State to employ in such capacity any person in the capacity of mine boss, fire boss or hoisting engineer, unless such person has a certificate of service or competency as provided in sections 1, 2 and 3 of this act, or to allow any person not having such certificate to continue in his employ in such capacity after three months from the time this act takes effect, unless he has procured such certificate.

Sec. 6. That for the purpose of providing for the expense of holding the examinations and issuing the certificates herein provided for, each applicant, before entering upon examination, shall pay the Inspector of Mines one dollar, a receipt for which must be endorsed upon such certificate before it becomes effective.

Sec. 7. That any person violating any of the provisions of this act shall be guilty of a misdemeanor, and, upon conviction, shall be fined in any sum not less than five dollars nor more than fifty dollars.

The bill providing for the use of pure oil passed the House of Representatives too late to be acted upon in the Senate, and that for the inspection of the smaller mines failed of passage in the House. I wish to return thanks especially to Senators Horner, Humphreys and McCord and Representatives Berry, Henderson and Williams for their efforts in behalf of the above legislation.

The miners of the State wished to have a law enacted providing for a uniform screen at all mines in the State. A bill drawn by their officials was introduced into both Houses and passed by each, but neither House acted on the bill passed by the other before final adjournment, so the law failed to pass. This was intended to take the place of the law passed in 1891 providing for weighing coal before screening, which was declared inoperative by the Supreme Court in the case of *Martin vs. The State*, 143 Ind., 545. This matter causes a great deal of friction between miners and operators, as screens are of different sizes, and in many instances screens have been changed after the price for mining screened coal had been fixed. By this means more coal is permitted to pass through the screen, causing a virtual reduction in the price paid for mining. On the other hand, those operators whose screens are of a different kind or size than was contemplated by the law claim that it would entail a large expense to make the necessary changes and be a burden to the business. Improvements in coal-handling machinery are introducing rolling and shaking screens, for which it would be very difficult to make provision in a law on this subject that can be made effective, without providing that coal shall be weighed before screening. The States of Illinois and Pennsylvania each enacted a law for this purpose during the past year, but its enforcement is being resisted in both States. When our Legislature again convenes we may have some light on the subject from the courts of those States to enable our lawmakers to frame a law that will give relief from the annoyance that arises from dissatisfaction with the present method of basing the price paid for mining. One of the features of the law passed last winter provides that operators shall make monthly reports of their production to the Inspector of Mines. In the past there has been a great deal of trouble in getting anything

near an accurate return of the coal production of the State, as many operators failed or refused to furnish the information. This year there is a marked improvement in this respect, and I hope that next year the returns will be reliable. As the law was effective only eight months of the current year they are not so in the present report. However, the basis for such estimates as were necessary is much broader than it has been in previous years.

EXAMINATIONS.

By an act approved March 5th, 1897, it was made unlawful for any person to perform the duties of a Mine Boss, Fire Boss or Hoisting Engineer without first having received a certificate of service or competency from the Inspector of Mines. Certificates of service are issued on satisfactory proof of three years' successful service in the position for which the certificate is issued. This office prepared the following form of application for this kind of certificate:

.....Ind., 189....
 To Robert Fisher, Inspector of Mines for Indiana:
 I.....hereby apply for a "Certificate of Service"
 in the State of Indiana, as provided by section 2, page 127, Acts 1897. I
 am....years of age, have been employed about mines for....years and
 have served as.....for....years, as follows:
 AtMine, from..... to.....
 AtMine, from..... to.....
 AtMine, from..... to.....
 I have successfully discharged the duties of such position, as shown
 by the annexed "Certificate of Employer" or "Affidavit"—(as the case
 may be). I here inclose One Dollar Certificate fee, and 4c postage, for
 which please mail certificate.

.....Applicant.
Ind.

CERTIFICATE OF EMPLOYER.

.....Ind., 189....
 This is to certify that
 has been employed by as at Mine
 for more than three years last past, has successfully discharged the duties
 of such position and is still so employed.
 Affidavit of two acquaintances—(to be used only in case "Certificate
 of Employer" in above form can not be obtained).
 State of Indiana.....County, ss.
 Personally appeared before me,a Notary Public,
 in and for the County and State aforesaid.....and

.....known to me to be reputable citizens of said County and State, who being duly sworn, say that they have for more than..... years past been acquainted with.....who is applying for Certificate of Service as.....in the State of Indiana, that they have known him to be engaged as ain said State for more than three years, as follows, to-wit:

At Mine, from..... to.....
 At Mine, from..... to.....
 At Mine, from..... to.....

That they were well acquainted with his work at each of said places and that to the best of their knowledge, information and belief, he has always successfully discharged the duties of said position, and is sober and competent.

Subscribed and sworn to before me, thisday of.....189...
Notary Public.

Note.—The right is reserved to require further proof if necessary.

INSTRUCTIONS.

1. Fill out and sign the application.
2. You should have employer make and sign the "Certificate of Employer" if possible.
3. If for any reason you can not get this Certificate, have two of your acquaintances go with you to a Notary Public and make the affidavit attached to this Application.
4. When you have filled the blanks as instructed above, mail as soon as possible to Robert Fisher, Inspector of Mines, Brazil, Ind. Enclosing one dollar for certificate and 4c in postage stamps.
5. If the papers are satisfactory, your "Certificate of Service" will be mailed to you shortly after next regular examination. Otherwise, they will be returned to you for correction.
6. Applicants for Service Certificates need not attend examinations.

ROBERT FISHER, Inspector of Mines.

As the law requiring certificates became effective on July 15th the "Certificate of Employer" has not been accepted as sufficient since that time, because any person having served after that date without a certificate did so in violation of the law. Though the instructions given answered all questions that had been asked about the matter up to the time the blanks were prepared, I was compelled to reject thirty applications for "Service Certificates" besides those which were returned and corrected.

Many of those whose applications were rejected passed examinations and received "Certificates of Competency." In only one case has there been manifested serious dissatisfaction with my rulings, when they were explained. To date there have been issued "Certificates of Service" as follows:

To.....Mine Bosses	119
To.....Holsting Engineers	185
To.....Fire Bosses	4

A list of the names and addresses of those to whom certificates have been issued is given below:

MINE BOSSES.—SERVICE CERTIFICATES.

C. H. Baetz, Evansville.	David M. Hopkins, Shelburn.
Joseph Peters, Alum Cave.	James Cuthbertson, Brazil.
George Mitch, Rosedale.	W. J. Price, Cardonia.
D. W. Davis, Cannelburgh.	Jacob Ehrlich, Sr., Turner.
Wm. Grey, Seeleyville.	T. J. Thompson, Hoosierville.
John Jennings, Ayrshire.	John Chesterfield, Sr., Brazil.
H. W. Jenkins, Perth.	Thomas McQuade, Burnett.
James Dunn, Linton.	H. A. Butler, Dugger.
Andrew Dodds, Littles.	Wm. T. Hopkins, Carbon.
John W. Odell, Evansville.	John J. Scott, Brazil.
Andrew Gilmour, Cardonia.	James F. Andrew, Clay City.
Ellsworth Tibbitts, Turner.	T. V. Robertson, Linton.
Thomas Fandla, Clay City.	Jos. W. Small, Washington.
John Crosby, Shelburn.	George A. Davis, Coxville.
Morgan Roberts, Mecca.	Henry Payne, Coxville.
James Skene, Mecca.	John E. Kelley, Boonville.
Henry Schlatter, Brazil.	Robert F. Bieler, Macksville.
James Johnson, Coal Bluff.	John Bolln, Brazil.
Herbert Wheatley, Linton.	Jos. Carmichael, Seeleyville.
R. C. Walker, Troy.	John W. Alvis, Seeleyville.
H. T. Brewis, Petersburg.	Pius Schulthels, Evansville.
J. R. Willey, Petersburg.	Walter Knox, Ashersville.
W. E. Evans, Eagle.	Edward Donnely, Seeleyville.
Wm. Wooley, Boonville.	Thomas Harris, Washington.
R. M. Freeman, Bicknell.	Isaac H. Williams, Rosedale.
S. C. Risher, Linton.	Wm. Conroy, Brazil.
Wm. Chesterfield, Clinton.	Wm. Spears, Brazil.
Jacob D. Lewis, Carbon.	Wm. Penze, Brazil.
Welty A. Jacobs, Raglesville.	Wm. Wilson, Cardonia.
D. J. Evans, Carbon.	Alfred L. James, Brazil.
Thos. R. Small, Washington.	J. W. Hawkins, Terre Haute.
R. J. Wallace, Diamond.	N. C. Walker, Rockville.
Robert Lauder, Boonville.	Frank Smith, Farnsworth.
Joseph Ferry, Linton.	Moses Marks, Cardonia.
H. B. Ehrlich, Brazil.	Chas. Harting, Edwardsport.
John Cox, Brazil.	Wm. Devoll, Seeleyville.
James A. King, Brazil.	Isaac H. Valentine, Rosedale.
Charles Nash, Coal Bluff.	Frank Lockhart, Linton.
Gus. Wellinger, Washington.	Louis Schultz, Petersburg.
W. H. Sexton, Linton.	Ed. Somers, Staunton.

Thomas Dalton, Carbon.	J. S. Tiley, Silverwood.
G. W. Briggs, Cannelton.	Andrew Winterbottom, Sullivan.
Geo. R. Anthony, Fontanet.	Peter Andrew, Clay City.
Thos. J. Thomas, Princeton.	Thomas Clemmitt, Linton.
Louis M. Gaisser, Evansville.	George West, Seeleyville.
Steward Shirkie, Silverwood.	Wm. Hutchinson, Voorhees.
James L. Devonald, Burnett.	James C. Pascoe, Linton.
John McAnally, Hymera.	A. W. Stuckey, Raglesville.
Jeff. Ladson, Burnett.	I. H. Wooley, Shelburn.
Patrick Bartley, Evansville.	D. B. Hall, Evansville.
Wm. F. Horst, Evansville.	Geo. Bonenberger, Evansville.
W. L. Wallace, Turner.	James McCombs, Shelburn.
A. M. Moreland, Eagle.	August Dutell, Ashersville.
J. P. Hargrove, Boonville.	John F. Perry, Del Carbo.
August Norkus, Diamond.	Simeon Wooley, Shelburn.
George A. Donie, Perth.	Wm. Gatt, Odd.
Samuel Campbell, Del Carbo.	Wm. Robertson, Newburg.
M. Atkinson, Edwardsport.	Jas. Dunlap, Brazil.
Geo. H. Sargent, Eagle.	W. A. Barrowman, Huntingb'gh.

HOISTING ENGINEERS.—SERVICE CERTIFICATES.

Wiley McCarty, Diamond.	James A. Harris, Littles.
Geo. Bolin, Harmony.	J. W. LaFollette, Shelburn.
Chas. Marshall, Harmony.	Wm. A. Cecil, Evansville.
James B. Downey, Bicknell.	Herman Ehrlich, Turner.
Chris. Menning, Clinton.	Ignatz Trappler, Washington.
Irwin Stewart, Del Carbo.	Fred Heiliger, Sr., Harmony.
Albert Marshall, Clay City.	John Dosch, Washington.
Wm. Downey, Bicknell.	Noah Manuel, Alum Cave.
Chas. Froment, Shelburn.	Barney Wilhelm, Evansville.
John Stewart, Staunton.	John Hunter, Macksville.
Ellet Froment, Shelburn.	Frank Yocom, Perth.
Hubert Haag, Cannelburgh.	Frank Purcell, Washington.
John Meakin, Turner.	Chas. Jackman, Washington.
J. N. Rettinger, Evansville.	John Kunkler, Washington.
Jas. Burroughs, Center Point.	Wm. J. Thomas, Clinton.
Wm. Frazer, Ashersville.	Thos. Foxworthy, Coal City.
Wm. Meakin, Staunton.	Nimiviah Bush, Shelburn.
A. D. Blacketer, Ayrshire.	Wm. Biggins, Diamond.
Robert Wylie, Rosedale.	Robt. F. Bleler, Macksville.
James D. Miley, Ayrshire.	John W. McCarty, Diamond.
T. M. Nelson, Littles.	Andrew Davidson, Coxville.
Marlin Rhodes, Clinton.	Grant M. Duncan, Brazil.
I. N. Cassaday, Montgomery.	Fred Heiliger, Jr., Harmony.
Jos. A. Kauble, Clay City.	S. N. Pritchard, Seeleyville.
Geo. C. Harth, Fontanet.	Grant McCurdy, Boonville.
Jos. W. Harth, Fontanet.	N. M. Humphreys, Linton.
R. Winningham, Seeleyville.	J. W. Yant, Ashersville.

Louis Helliger, Harmony.	Harry C. Duncan, Brazil.
John A. Sharps, Carbon.	John L. Wilson, Washington.
David Reynolds, Center Point.	Wm. M. Boling, Coal Bluff.
Roy A. Somers, Staunton.	O. D. Bowles, Brazil.
James Kimlo, Blackburn.	Wilmer Strawn, Eagle.
John J. Laurent, Eagle.	James Gilmour, Cardonia.
Wm. Loyd, Shelburn.	John Gilmour, Brazil.
R. G. James, Burnett.	Noah Brillhart, Brazil.
E. W. Helton, Brazil.	Arthur DeCamp, Diamond.
Algie A. Church, Clay City.	Pearl Milburn, Brazil.
Zeno Calvert, Clay City.	L. S. White, Linton.
Luther Pullen, Knightsville.	Orion Rose, Petersburg.
Thos. Davidson, Shelburn.	James M. Toppas, Rosedale.
Aaron Martin, Knightsville.	W. S. Fulwider, Mecca.
Harry H. Cotterill, Oakland City	John E. Azbell, Vincennes.
Albert Hixon, Carbon.	Harry T. Reed, Brazil.
Geo. Wood, Petersburg.	Wm. Snedden, Knightsville.
Thos. Lauder, Boonville.	John Moore, Brazil.
Daniel Kincaid, Diamond.	Thomas Judson, Fontanet.
John Miller, Linton.	Truman Hedge, Boonville.
S. Winningham, Seeleyville.	Hulbert Schec, Macksville.
Robt. Schofield, Washington.	Wm. Burroughs, Center Pt.
John Stiner, Dugger.	D. McPherson, Seeleyville.
James Parfitt, Brazil.	Thos. Potter, Macksville.
Henry Herrington, Fontanet.	Louis Lauby, Washington.
Thomas B. Brooks, Carbon.	J. W. Dunbar, Washington.
Henry Heacox, Harmony.	James McCarty, Diamond.
Thomas Alderson, Harmony.	John Green, Montgomery.
T. W. Thomas, Clinton.	Frank Stanley, Burnett.
J. W. Hardin, Carbon.	Thos. W. Jones, Boonville.
Edwin S. Boling, Coal Bluff.	Nich. Polaskovitch, Brazil.
Henry Poff, Burnett.	Andrew Kennedy, Sr., Perth.
Wm. Morris, Coal Bluff.	J. C. Hopkins, Linton.
Jos. R. McCafferty, Augusta.	Robert Jones, Alum Cave.
Andrew Kennedy, Jr., Perth.	Van Partington, Evansville.
Lee Morris, Clinton.	David Thomas, Brazil.
Joseph D. Brown, Coal Bluff.	W. J. Hancock, Farnsworth.
Wm. Lauder, Boonville.	Robert O. Pruett, Coxville.
Griff Howells, Center Point.	Leslie C. Frazer, Knightsville.
Levi B. Cramer, Shelburn.	Ira Champer, Seeleyville.
Wm. H. Field, Vincennes.	Joseph Church, Washington.
S. D. Holbert, Rosedale.	Otto Hartloff, Chandler.
W. T. Cassity, Fontanet.	Jesse B. Auman, Ashersville.
Louis F. Bergenroth, Troy.	Rufus Bowles, De Forest.
John J. Bergenroth, Troy.	Andrew J. Blair, Harmony.
John Vonderschmidt, Linton.	J. N. Broadhurst, Macksville.
Wm. Judson, Fontanet.	George Watson, Vincennes.
Geo. Biggins, Diamond.	Fred Collins, Coal Bluff.
Wm. Spears, Brazil.	Ross Vansickle, Silverwood.
Frank Bard, Brazil.	W. W. Fisher, Ashersville.

Sam W. Gentry, Macksville.	Fred McClanahan, Hymers.
P. Krackenberger, Macksville.	John R. Dickson, Brazil.
Richard G. Gentry, Macksville.	Wm. F. Somers, Staunton.
Thos. Andrew, Clay City.	John Davidson, Coxville.
L. B. Southard, Huntingburgh.	C. A. Taylor, Clinton.
Harvey Cochran, Sullivan.	

FIRE BOSSES.

Thomas J. Thomas, Princeton.
Joseph Drovetta, Vincennes.
Wm. Norton, Shelburn.
Evan Davis, Shelburn.

Section 4 of the act above provides that "within sixty days after this act takes effect examination shall be held in each of the cities of Brazil, Terre Haute, Washington and Evansville, and that previous to the first of such examinations the Inspector of Mines shall make public rules and regulations under which such examinations shall be held." In compliance with this provision of the law the following circular was published, and notice was given by publication in "The Clay County Enterprise," "The Terre Haute Express," "The Washington Gazette," and "The Evansville Journal," of the time and place of the examination in the cities in which said newspapers are published.

The circular referred to is as follows:

To Whom It May Concern:

By an act of the Legislature of Indiana, approved March 4, 1897 (Cap. 84, Page 127, Session Laws 1897), in effect April 15, 1897, persons employed as Mine Bosses, Fire Bosses or Hoisting Engineers at coal mines in this State, after three months from the latter date, must have certificates of service or of competency signed by the Inspector of Mines. Certificates of the first class will be issued upon satisfactory evidence being presented to the Inspector that the applicant has successfully served in or about the mines of this State for three years or more, in the capacity for which he desires a certificate. Blanks on which to make this proof will be mailed about May 1st to all persons asking for them by mail.

Certificates of competency will be issued to all citizens of the United State who satisfactorily pass a public examination as to their fitness to discharge the duties of the position for which they desire certificates.

The following rules have been adopted to govern the first series of examinations held under the law:

1. Examinations will be held at Brazil, Indiana, Saturday, May 22d, 1897; Terre Haute, Indiana, Tuesday, May 25th, 1897; Washington, Indiana, Thursday, May 27th, 1897, and Evansville, Indiana, Saturday, May 29th, 1897. The hour and place of examination will be published twice in a weekly paper of the city where the examination is to be held, giving at least 15 days' notice.

2. The examination will be by a series of printed questions, given to each applicant on the morning of the examination. Answers to the same must be written on one side of ruled foolscap paper and numbered to correspond with the questions. Oral questions may be asked in addition if deemed necessary by the Inspector to test the knowledge of the applicants.

3. The examination for Mine Bosses will embrace questions on the "mining law of the State;" "examination of hoisting ropes, safety catches, cages and scales;" "ventilation of mines;" "safety of shafts, entries, rooms and pillars;" "drainage and haulage roads," and "handling men."

4. The examination for Fire Bosses will embrace questions on the "mining laws of the State," "ventilation of mines," "gases of explosive nature," "safety lamps," "detecting fire damp," and "clearing working places."

5. Examination of Hoisting Engineers will embrace questions on "mining laws of the State," "steam boilers and water," "steam and steam engines," "ventilating fans," "examination of wire ropes and safety appliances," and "pumps."

The questions will be so arranged that the work can be done in four hours by a fair penman who knows his subject, but six hours will be given in which to do it.

The above is intended to be suggestive and contains all that I can consent to give to any possible applicant before the day of examination, and I must decline to answer letters on the subject, except to send the blanks referred to above.

ROBERT FISHER, Inspector of Mines.

Brazill, Indiana, April 17th, 1897.

While holding this series of examinations it was learned that quite a number of Hoisting Engineers who had not served in that capacity in this State long enough to entitle them to "Certificates of Service" did not have sufficient education to pass a written examination, while they were well recommended as careful and competent workmen by their employers and others. Several of them requested an oral examination at the time specified in the notices of examination. As Rule 2, published, stated that the examination would be in writing I refused to grant the request. As I had some doubt of my power to hold an examination where part of the applicants took a written and part an oral examination, I submitted this and some other questions to the Attorney General for his opinion. The correspondence follows:

Robert Fisher, Esq., Mine Inspector:

Dear Sir—Answering the inquiries contained in your undated letter, handed me this morning, I beg to say:

Yes, to the first and second which are as follows:

(1) Under Section 4, Page 127, Acts 1897, is an examination entirely oral permissible?

(2) Is an examination entirely written permissible?

No, to the third which is as follows:

(3) Can an examination at the same time and place be held allowing the candidate to elect either written or oral examination, different lists of questions being used?

It is for the Inspector to elect or decide upon the propriety of an oral or written examination, and not at all for the candidate.

To the fourth, that the examination should take place at the cities named when and as in the opinion of the Inspector there is just occasion for it, and it might well be that there would be no occasion for an examination in one at a particular time when it might be very necessary in the other.

For answer to the fifth: The General Assembly has selected the particular cities in which examinations are required to be held. I doubt the right of the Inspector to have examinations held elsewhere, and yet, I can see no one who can complain, if circumstances should make it apparent that it was more convenient and therefore desirable to hold the examination at some other place. The better practice, however, is to conform to the letter of the law where that is practicable.

I have the honor to be

Yours very truly,

WILLIAM A. KETCHAM.

Indianapolis, June 17, 1897.

Attorney General.

Acting upon this opinion, and to afford an opportunity to all desiring certificates to secure them, I issued the following circular and published notice of the examination as required by law:

To Whom It May Concern:

Notice is hereby given that on the 8th day of July, 1897, I shall hold an oral examination of applicants for Certificates of Competency as Hoisting Engineers, and on the 9th day of July a like examination of applicants for Certificates of Competency as Mine Bosses and Fire Bosses at the coal mines of Indiana, at the Court House, in the city of Terre Haute. Examinations will begin at 9 o'clock a. m., and continue till all applicants who present themselves have been examined under the following rules:

1. All persons desiring to take the examination must notify me by mail before July 7th, 1897, or present themselves for examination at the hour named above for examination of their class.

2. Applicants will be examined separately, but one applicant at a time being permitted to be in the room where the examination takes place. To all other persons the examinations shall be public.

3. Before entering upon examination each applicant must make a statement that he has not been informed by any person of the nature of any material question used on the examination, nor received any assist-

ance in preparing for the same since the examination opened, and promise that he will not divulge anything that transpires in the examination room until the last applicant has been examined.

4. Upon entering the examination room the applicant must deliver to the Inspector of Mines all books, papers and memoranda which might be used by him to assist in answering questions that might, or may be, asked him on his examination.

5. The examination will be by a list of written questions which will be read in their order to each applicant. If he does not understand the question he may ask for an explanation before attempting to answer, but not after.

6. The examination of Hoisting Engineers will include questions on the use, care and repair of boilers, engines, hoisting machinery, ventilating machinery, and pumping machinery, including fuel, water, lubricants, etc.

7. The examination for Mine Bosses will include questions on sinking, timbering and equipping shafts, development, ventilation and drainage in the different veins and mines found in Indiana, also accidents and the means of preventing them.

8. Examination of Fire Bosses will include questions on safety lamps, testing for gas, removing gas, ventilating of gaseous mines, and gaseous mines of Indiana.

9. Questions on the Mining Laws of Indiana. Copies of the edition of 1895 will be furnished free on request. The 1897 edition is about ready for delivery to those who have ordered it.

10. Answers will be graded as given and results announced at the close of each day of the examination.

11. This circular contains all information that will be given previous to the day of examination.

ROBERT FISHER, Inspector of Mines.

Brazil, Indiana.

Examinations have since been held in Evansville, September 22d, and Terre Haute, September 28th and October 23d. The following table shows the number of applicants at each examination, Certificates granted and Applications rejected:

EXAMINATION AT	Date.	APPLICANTS.			CERTIFICATES.			REJECTED.		
		M B.	F B.	Eng.	M B.	F B.	Eng.	M B.	F B.	Eng.
Brazil	May 22	22*	1	12	14	1	10	7	0	2
Terre Haute	" 25	28	1	11	22	1	11	7	0	0
Washington	" 27	9	0	4	8	0	3	1	0	1
Evansville	" 29	5	0	4	5	0	4	0	0	0
Terre Haute	July 8-9	18	1	7	13	1	6	5	0	1
Evansville	Sept. 22	5	2	8	3	2	8	2	0	0
Terre Haute	Sept. 28	19	1	13	14	1	8	5	0	5
Terre Haute	Oct. 23	7	1	8	5	1	6	2	0	2
Totals		113	7	67	84	7	56	29	0	11

*One applicant not a citizen of the United States.

This table shows that of 187 applicants 147 passed the examination and 40 failed, a percentage of failure of $21\frac{1}{2}$. This in spite of the fact that there is nearly a total absence of technical questions in the examinations. We have endeavored to so frame the questions as to test the practical knowledge of the applicants, and not to allow practical and successful men to be displaced by others who, while they may have made a theoretical study of the subjects pertaining to the business, have little or no practical experience in the duties of the position for which a certificate is desired. I herewith give a sample of the questions used for each kind of certificate. These will give a fair idea of the scope of the examinations held to this date. Future examinations will be made more difficult, with a view of increasing study among those affected by them:

QUESTIONS FOR THE EXAMINATIONS OF MINE BOSSES IN THE STATE OF INDIANA, AT WASHINGTON, MAY 27, 1897.

1. Give your name, age and postoffice address.
2. Where were you born? If abroad, when and where were you naturalized?
3. What in your judgment are the necessary qualifications in a successful Mine Boss?
4. Describe the duties of a Mine Boss as provided by the law of the State of Indiana.
5. In what capacities have you been employed in coal mines, and how long in each capacity?
6. How do gob fires originate in mines? What are the best means to put them out, and how would you guard against them?
7. What precautions are necessary to prevent falls of roof or coal? How would you induce workmen to take those precautions?
8. What are the causes of foul air in mines? How would you discover the presence of black damp? white damp? explosive gas?
9. The velocity of the air current as shown by the anemometer is 280 feet, the air course is 9 feet wide and $4\frac{1}{2}$ feet high, what amount of air is passing?
10. How many ways are there of producing a current of air to assist in ventilating a coal mine?
11. How do you determine the amount of air circulating in a mine?
12. What means can be used to increase the amount of air circulating in a mine without increasing the power used to produce the current?
13. Name the heaviest and the lightest gases met with in coal mines. In what parts of the mine would you expect to find each?
14. If an entry is driven at an angle of one-third with the face of the coal, how far apart would rooms on the face have to be turned to give rooms 21 feet wide and pillars 12 feet thick?
15. What persons are prohibited from working in the coal mines of Indiana, and what precautions that these provisions of the law are complied with?

16. Name some of the bad results of poor drainage in mines.
17. Describe the best means of constructing a haulage road where the bottom is soft and makes a good deal of water.
18. If you were not getting out the amount of coal that you should with the forces employed, what means would you take to discover the cause?
19. If miners or other workmen in your mine were in the habit of leaving doors open in the mine, or in any other way violating the law, what steps would you take to put a stop to the practice?
20. In a certain mine the main entries are advanced 500 feet on one side of the shaft and 350 feet on the other side. Two pairs of cross entries are working on each side of the shaft. The first pair are advanced 350 feet, the second 250 feet, the third 250 feet and the fourth 100 feet. Rooms are turned off the cross entries every 35 feet. The air splits at the bottom and measures 25,000 feet at the downcast. The mine worked six days in April, 1897. Make out the monthly report to the Inspector. (Blanks furnished.)

QUESTIONS FOR THE EXAMINATION OF FIRE BOSSES.--INDIANA, MAY, 1897.

1. Give your name, age and place of birth.
2. If born abroad, have you been naturalized? When and where?
3. What is the duty of a Fire Boss as provided in the mine law of Indiana?
4. How would you learn whether a safety lamp is in condition for use? Name three defects that would render it unfit.
5. In what part of a mine is fire damp most likely to gather? What conditions of the ventilation of a mine make the accumulation of gas most likely?
6. How would you prevent the accumulation of gas in the worked out parts of a mine?
7. Under what conditions would it be safe to use open lights in a place that makes fire damp?
8. What record would you keep of your daily examinations for fire damp?
9. How fast should the air current travel in places where there is likely to be a dangerous amount of gas generated?
10. What is the first indication given by the safety lamp of the presence of gas? What other indications as the amount of gas increases?
11. What kinds of safety lamps are you familiar with?
12. What dangers are met by a rescuing party in a mine after a serious explosion of fire damp?
13. What means would you use to overcome such dangers?
14. What experience have you had in gaseous mines? In what capacity?

QUESTIONS FOR THE EXAMINATION OF HOISTING ENGINEERS, AT TERRE HAUTE,
IND., OCTOBER 23, 1897.

1. What do you consider the most essential qualifications of a Hoisting Engineer?
2. Who may be placed in charge of a hoisting engine under the laws of Indiana?
3. In a general way describe the principles involved in the construction of steam boilers.
4. Describe two ways of setting boilers and how provision is made for their expansion and contraction.
5. Do the flues and tubes used in boilers increase or diminish their strength? Give reasons.
6. Where should water gauges be placed on a boiler? Why are steam gauges necessary?
7. Describe three different kinds of grates with which you are familiar.
8. Describe the principle of the safety valve.
9. The shell of a plain cylinder boiler is 30 inches in diameter and 20 feet long, and is made of single riveted wrought iron boiler plate three-eighths inches thick. What pressure can it carry safely?
10. How is a forced draft produced in a boiler furnace?
11. What different kinds of stress, or strain, is placed upon the different materials used in a hoisting outfit, including boilers?
12. What should be the smallest rope used to hoist two tons of coal, the cars, cage and rope weighing 3,500 pounds?
13. What different kinds of bolts are used in the construction of a steam engine? Tell where one of each kind is used.
14. An expansion joint is to be placed in a line of steam pipe 450 feet long. How much movement should it have?
15. What different methods are in use to fasten wheels and pulleys rigidly to shafts?
16. Suppose a spur wheel broke and you wished to order a new one, where would you measure the diameter of the old one?
17. Name the parts of a plain slide valve engine to which motion is imparted when running.
18. Describe the course of steam from the boiler to make a complete revolution of the cranks.
19. How does the reverse link produce the desired result?
20. Give the changes made in the direction of motion in hoisting a cage from a shaft, and by what mechanism each change is produced.

On August 2d the following circular was published and distributed to all persons holding certificates and to all operators of mines employing ten or more men, as far as such operators had come to the knowledge of this office:

To Whom It May Concern:

I herewith publish a list of persons who have been granted certificates under the provisions of "An Act to provide for the examination of Mine Bosses, Fire Bosses and Hoisting Engineers at coal mines, etc.," p. 127, Acts 1897.

While in terms this law applies to all mines in the State, construing it in connection with other mining laws, this office holds that it applies only to mines employing more than ten men. However, if more than this number are employed at any time, even for a day, the person acting in either of the above capacities, without a certificate, is liable to be fined, as is the person, firm or corporation employing him. The theory of the law is that all persons entrusted with the performance of the duties of either of the above positions should be able to demonstrate their competency by passing an examination, but as a special favor to those who have served in either of those capacities for three years, in this State, they are exempted from such examination. A service certificate, therefore, does not indicate any opinion of the Inspector of Mines as to the competency of the person holding it, though it has the same force and effect in protecting the employer from a criminal prosecution as a certificate of competency. Certificates of competency are granted only after an examination, and are, in effect, a recommendation from the Inspector to the extent indicated by the percentage earned.

It is the duty of the Inspector of Mines to file affidavits against all persons holding, or giving, employment to persons not provided with certificates, as soon as evidence sufficient to secure conviction can be secured, either from personal investigation, or through other witnesses. Persons affected will govern themselves accordingly.

Examinations will be held within three weeks at any time after twenty-five applications, accompanied by the fee of \$1.00, have been received at this office. The convenience of the greatest number of applicants will determine the place where examinations will be held. No certificates will be issued until after the next general examination.

As inquiries are frequently addressed to this office for persons to fill positions, it will be of mutual advantage to all interested if all certificate holders who desire to change location would notify me by mail of such desire, where position is wanted, and salary expected, so that I can put parties into communication with each other. Hoping that by co-operation we may be able to raise the standard of efficiency in the positions covered by the law, I am,

Respectfully,

ROBERT FISHER, Inspector of Mines.

Brazil, Indiana, August 2, 1897.

I found it necessary to institute legal proceedings in several cases where the law was being violated flagrantly, but in only one case was any defense made. In that, the case of the State vs. William Horst, before — Poole, J. P., at Evansville, Indiana, the defendant was found guilty and fined five dollars and costs. No appeal was taken, so that no case has been tried in a higher court. All other parties against whom affidavits were filed pleaded guilty.

Several complaints have reached this office of persons who occasionally hoist coal and men at places where a properly certified man is in charge. I have uniformly refused to file charges in such cases, as I believe the spirit of the law permits such action as a part of the training and experience necessary to fit persons to pass examinations in the future. It appears to me that any other construction of the law would debar citizens of our State from securing the necessary preliminary practice to fit them to take charge of hoisting machinery and would limit our future choice of Hoisting Engineers to those who had obtained their practical knowledge of the business in another State or to those who had a purely theoretical knowledge. While the privilege may be abused by allowing incompetent men to have temporary charge, the remedy is with the certified men who have the responsible positions, and not at law.

The following is a list of those who have secured certificates of competency at the various examinations:

MINE BOSSES—CERTIFICATES OF COMPETENCY.

M. McMorrow, Brazil.	J. S. Newport, Linton.
Alex. Orr, Harmony.	Ed. Stewart, Hymera.
James G. Biggins, Perth.	G. E. Broadhurst, Macksville.
Thomas Orr, Harmony.	Wm. P. McQuade, Brazil.
Roland Elstone, Diamond.	James Watters, Clay City.
R. F. Jenkins, Knightsville.	George Epperson, Linton.
R. M. Irving, Knightsville.	Thos. Gregory, Fontanet.
Joseph W. Williams, Brazil.	David W. James, Clinton.
Andrew Spears, Brazil.	Wm. Devonald, Clinton.
George Myers, Brazil.	W. A. Edwards, Clinton.
Samuel Lindsay, Brazil.	John Archer, Clinton.
John Mushett, Terre Haute.	Duncan McCallum, Clinton.
P. J. Mooney, Brazil.	C. C. Hall, Shelburn.
Mike Hofmann, Ashersville.	George L. Potts, Diamond.
G. C. Potter, Augusta.	Griff Howell, Center Point.
Thos. R. Small, Washington.	Thomas Parr, Fontanet.
Thomas Harris, Washington.	Wm. Britton, Alum Cave.
W. H. Walton, Linton.	James Steele, Macksville.
Geo. B. Brown, Montgomery.	Alex. Faulds, Alum Cave.
Jas. B. Brown, Washington.	John Paton, Lyford.
Joseph Fennel, Linton.	Wm. R. Scott, Vincennes.
Richard T. Jones, Princeton.	Frank Gendthar, Evansville.
Hugh Monahan, Evansville.	John A. Bolln, Harmony.
Geo. F. Archbold, Newburgh.	Fred Eberwine, Knightsville.
H. L. Williams, Troy.	Thos. J. Russel, Cardonia.
Wm. T. Conroy, Brazil.	R. J. Monkhouse, Coal Bluff.
Martin Navin, Diamond.	John Watters, Clay City.

James McInnis, Carbon.	James M. Coakley, Cardonia.
John Chesterfield, Jr., Brazil.	John A. Beck, Dugger.
James Baxter, Cardonia.	Michael Doyle, Brazil.
John A. Templeton, Linton.	Frank Dunlap, Clinton.
Samuel Thorpe, Linton.	Thomas G. Marshall, Carbon.
A. L. Boore, Clay City.	John Quigley, Carbon.
Frank J. E. Urbain, Brazil.	A. D. Scott, Del Carbo.
J. F. Erwin, Macksville.	Hugh Kirkland, Perth.
David John, Shelburn.	P. H. Penna, Linton.
Bartly Stinson, Sophia.	J. W. Risher, Linton.
W. A. Jackson, Oakland City.	Wm. L. Erwin, St. Mary's.
A. H. Zimmerman, Mecca.	J. R. Horsfield, Knightsville.
John L. Suttle, Cardonia.	D. Bogle, Clinton.
Wm. Wilson, Cardonia.	Valentine Martin, Rosedale.
James Burt, Cardonia.	Wm. F. Brown, Alum Cave.

FIRE BOSSES—CERTIFICATES OF COMPETENCY.

Fred Brink, Coal Bluff.	Wm. Woods, Princeton.
Robert M. Irving, Knightsville.	Richard T. Jones, Princeton.
Chas. Sheridan, Diamond.	Jos. W. Horsfield, Knightsville.
David John, Shelburn.	

HOISTING ENGINEERS—CERTIFICATES OF COMPETENCY.

William Milburn, Cardonia.	Robert Biggins, Diamond.
John Beaton, Brazil.	John Cloyd, Rosedale.
Walter Irwin, Brazil.	Benj. Smith, Linton.
Wm. Vanlieu, Lyford.	John Dorman, Burnett.
D. H. Collier, Diamond.	Lee Wehr, Lyford.
Milton Smith, Diamond.	Thomas Gregory, Fontanet.
A. G. Collier, Diamond.	Joseph Haag, Washington.
Ed. Butts, Diamond.	Ambrose Cramer, Rosedale.
W. C. Biggins, Diamond.	Frank Ritzel, Evansville.
Thomas McNair, Carbon.	Alexander Maule, Princeton.
W. J. Hinkle, Hymera.	Smith H. Abshire, Newburg.
H. C. Cummins, Hymera.	W. J. Price, Montgomery.
Thomas Shannahan, Mecca.	Robert Hall, Evansville.
Benjamin F. Lyday, Lyford.	James W. Powell, Evansville.
Jona E. Meredith, Linton.	Thomas Roberts, Evansville.
G. F. Archbold, Newburgh.	Albert Lynch, Princeton.
H. M. Graves, Voorhees.	Frank Turber, Princeton.
E. R. Dickle, Dugger.	Charles Sterne, Francisco.
W. C. Ringo, Edwardsport.	Michael B. Miller, Evansville.
Austin Jackson, Clinton.	Charles E. Boots, Macksville.
Wallace Boone, Merom.	R. O. Pruett, Coxville.
C. F. Thorpe, Linton.	Mellie S. Hunter, Montezuma.
Frank Craft, Clinton.	Clarence Strader, Seeleyville.

Curtis Redding, Mecca.	Claude Erwin, St. Mary's.
A. H. Zimmerman, Mecca.	Otis Bledsoe, Lewis.
Geo. W. Rice, Coxville.	J. W. Davis, Brazil.
Mahlon R. Gustin, Sullivan.	Charles Woolf, Lyford.
John S. Robertson, Newburg.	Wm. F. Brown, Alum Cave.

MAPS.

The law requiring maps to be made and filed with the Inspector of Mines has been very generally complied with. The strike which began July 4th and lasted until the middle of September interfered materially with the making of maps at some of the mines that were allowed to fill with water. At others, where the roof was bad, it was allowed to fall in places, so as to make a complete survey impossible, and so maps were not filed within the time limited. Where such causes existed I have not taken advantage of the provision of the statute authorizing the appointment of an engineer to make the survey and maps. This has been done only in cases where there seemed to be a willful disregard of the provisions of the law, and in several instances when appointments were made the owners of the mines made contracts with the engineer for the work. In only two instances have any complaints been made of the operation of the law in this respect. Several of the maps furnished do not comply with the law in all respects, but as they evidence a disposition on the part of mine owners to keep within the law, I have not insisted upon their being corrected at this time. The law provides that all maps shall be corrected each year between May 1st and September 1st, and I shall insist on the work next year being done by a competent person and on having the details properly shown on the maps. In regard to the necessity of correct maps I cannot do better than quote from the first report of the Mine Inspector of this State:

"I cannot exaggerate the importance of having correct plans. When our present mines are abandoned and filled with water these maps will have to guide us in future mining operations, and if they are misleading we should be much better without them, for they may cause much destruction of life," and from the report of 1883: "A great expense and annoyance is occasioned in approaching an abandoned mine where the extent of the worked-out territory is not known. The survey and map should be made by a practical surveyor, so that the accuracy of the survey could be relied upon. When a mine is worked out and abandoned all trace of it may disappear in a few years." In the case of mines working toward abandoned works we have had several examples lately of the expense attending approaching them without a map,

in one case a bore hole having been kept ahead of the workings for over 300 feet. In another case where apprehensions were felt as to the danger of breaking into an old mine, of which a map had been filed, a survey showed that the workings of the two mines were nearly 500 feet apart, and work was continued for more than a year without the expense attending upon keeping a drill hole in advance. But this does not appeal to mine owners, as the benefit derived from it will be received by future operators. But a correct working map is a present benefit in many ways. It has a tendency to secure a more systematic working of the mine, to keep the workings in such a shape that the greatest possible amount of coal is finally recovered from the pillars and to prevent accidents from shots blowing through pillars. In many instances an accurate map of a mine would have prevented costly litigation over property injured by roof falling on account of insufficient pillars being left to support it, and on account of trespassing on coal out of the proper lines. The value of the maps to this office lies principally in the assistance they render in understanding the monthly reports of Mine Bosses and their use as a guide to the mines on visits of inspection. We have received great benefit in these ways, and their value to a new incumbent of the office would be inestimable. One survey was made during the year at the request of an adjoining landowner, where a coal company was supposed to be trespassing on his land, which the survey showed to be true. The matter was amicably adjusted by the parties on the basis of the survey, and no certified copy of the map was necessary. This survey was made at the mine of the Currysville Coal Co., near Shelburn, on March 10th, 1897. No prosecutions have been instituted for failure to furnish maps, and I think none will be necessary.

DESCRIPTIONS OF MINES.

During the year 1897 mines employing more than ten men have been operated in the counties of Clay, Daviess, Dubois, Fountain, Gibson, Greene, Knox, Martin, Owen, Parke, Perry, Pike, Sullivan, Vanderburgh, Vermillion, Vigo, Warrick. I give below brief descriptions of the several mines in each county:

CLAY COUNTY.

BRAZIL BLOCK COAL Co.'s No. 1.

Located in the north part of the city of Brazil, on the C. & I. C. Railroad. Electric Mining Machinery is used. The shaft bottom is lighted with incandescent lamps. In securing the roof at the bottom of the shaft, instead of the timbers usually employed for this purpose, legs of 4½-inch diameter gas pipe and cross bars of railroad iron are used. These are lagged overhead with 2-inch oak timber. The result to date is highly satisfactory, as there has been no necessity for repairs since the mine was opened, though the roof is one that is very sensitive to the action of air, and in mines of this vein where timber is used it requires frequent renewal, and the roof gives a great deal of trouble. The double partings at the bottoms are floored, and with good tracks, the handling of coal is made comparatively easy. The underclay is soft, making it necessary to corduroy the hauling roads, as a great deal of water is coming into the mine from others that have been worked out and abandoned in territory surrounding it, the Campbell, Morris and Black Diamond having opened the most territory. Where corduroy is not used the roads are very muddy. For convenience in handling machines the bottom is taken up in all entries and nearly all rooms, so that it is very hard to keep water off the roads. Where the roof will admit of it, rooms are driven double 50 feet wide, with a road on each side and the refuse gobbled in the middle. This gives an opportunity for the circulation of air around the working face at all times. Ventilation is good in all the entries, but as machine mining requires shot firing at all hours of the day, the air is smoky at times, requiring a great deal more than the statutory amount of air to be kept in circulation. Keyes' Automatic Mine Doors are used on the main airways and have given very good satisfaction. The roof requires constant attention, and it reflects credit on the management that so few accidents from falling of roof have occurred in the mine during the year. The last inspection was made November 10th, 1897, and very few recommendations were found necessary, and nearly all of the defects were easily remedied. The air is split to afford five separate currents of air to different sections of the mine. The largest section has but 30 men in it.

GART NO. 3 MINE.

Located on the Harmony North Branch of the E. & T. H. Railroad one and one-fourth miles north of the main line. It is in territory that is nearly surrounded by abandoned works, and makes a great deal of water, six pumps being in use at the mine. On two occasions during the year the mine was laid idle on account of the water rising at the shaft. The works and the escape ways are so located that no danger to the workmen is to be apprehended from this source, however. The mine is fitted with self-dumping cages, the mine car remaining on the cage and being emptied without handling by the top men. This result is displacing one or two laborers on the pit top, the weighman doing all the work.

Two veins are worked in the mine, the coal from the upper being brought through a tunnel to the lower vein and hoisted from the bottom of the shaft. The works on the southeast side of the shaft are worked out and abandoned.

The roof in the bottom vein is good in most places, but the coal lies uneven, giving a very irregular haulage way, the grades being heavy, and making the haulage very costly. The roof in the top vein is fair, but requires a good deal of timber to keep it safe. The water from the upper vein is drained through drill holes to the lower vein and from there brought to the surface by pumps. Some of these are operated through bore holes from the surface reaching low places in the workings, thereby doing away with a great deal of piping and ditching underground, the steam pipes being laid from the boiler along the surface of the ground.

This helps to improve the ventilation by allowing the air passing through the mine to be kept free from the heat from a long line of steam pipe and from the exhaust steam from the pumps. Rooms and entries are worked standard width, as given in another part of this report, and are well drained and timbered where necessary. When the last inspection was made, November 10th, 1897, the ventilation was fairly good, but the air that was coming from the fan should have furnished a better current at the working faces. This was due to some extent to a door on the main air course being open a great deal, and to some of the air courses being used for stowage by miners, who lacked pure air in consequence. This is a thing that requires constant vigilance on the part of mine foremen, as workmen are in the habit of putting dirt, timbers, tools, etc., into the breakthroughs and thereby

choking the air-passage of the mines. Good ventilation can be secured at least expense by keeping airways clean. Owing to this mine being idle so much during the year it had been allowed to get into bad condition and had not been fully repaired at the time of my visit, but it appeared that Mr. Conroy was pushing the work with all possible speed.

GART No. 5 MINE.

Situated in the town of Cardonia, on the Knightsville North Branch of the T. H. & I. R. R. This is the largest mine in the Block Coal District worked exclusively by pick miners. At the time of last report the output was greatly reduced on account of its original territory being nearly worked out. Since then some territory has been acquired on the east, and a cut has been made to the south, which opens up a large field of coal. The production at the time of my last regular inspection was 600 tons of screened coal per day. About one-fifth of the coal goes through the screen, making the total production 720 tons daily. The roof is good and there is comparatively little water to contend with, so that the haulage roads are in good condition, but very heavy grades are met with, which greatly reduce the hauling power of the animals employed. As an illustration of this fact I may remark that the cut above referred to, being made nearly level on the bottom for a distance of 500 feet, has a depth of over 20 feet near the middle. At the time of my last regular inspection, October 22d, 1897, a tunnel was being driven to the upper vein of block coal, which had reached the coal at the time of my later visit. When this is opened it should add materially to the output of the mine. For the first time since this mine was opened I found the ventilation badly deficient on October 22d. Along the entry going northeast was a line of steam pipe which warmed the air almost to the suffocating point, and though it had cooled considerably before reaching the working places, it did not have the life-giving force that it should have. In this part of the mine, near the face of the last entry, water sometimes accumulates and interferes with the air current. While I should have been pleased to see this in better condition, I did not insist on the necessary changes, as this part of the mine will soon be abandoned. On the south I found a great deal worse state of affairs. The entry, which is now being used as a haulage way, had gone over an extensive rise, and the coal for a great part of the distance was thin, in some places less than two feet. The air course following the entry was made only the height of the coal; at the time it was driven only

four men were at work there. When the haulage road was cut through no steps had been taken to increase the size of the airway. On the date above given I found 141 men and several mules at work in that part of the mine, and at least half of them were without sufficient air. If my authority had extended so far I should have ordered at least 40 men out of the mine, but the law provides, "Whenever the Mine Inspector shall find men working without sufficient air * * * he shall first give notice to the owner, operator, agent or lessee, a notice giving facts, and a reasonable time to rectify the same." I did this, and on my return found the conditions somewhat improved and work being pushed with reasonable diligence to still further improve it. The air course referred to was being enlarged by taking coal off the side and by taking down the roof, and another opening will shortly be made from the top vein to the surface in this part of the mine. This will, in my opinion, give sufficient ventilation for all men who are likely to be employed there in the future. However, the management could not be too strongly condemned for delaying this necessary work so long.

BRAZIL BLOCK COAL CO.'s No. 8 MINE.

Located on the Coal Bluff Branch of the C. & I. C. R. R., near the north line of Clay County. Only the lower vein is now being worked. The output at present is about 400 tons of block coal daily. Adding screenings, the total will reach 500 tons. The production is restricted at present, owing to the difficulty of securing men to load coal after machines. Miners seem to prefer pick work when it is possible to get it, and men have been in demand ever since the settlement of the strike in September. While this mine employed 233 men in March, the managers could secure only 160 in October. The mine is laid out to be a large producer. Nearly all entries radiate from near the bottom of the shaft, and with roomy partings or sidings, give plenty of room to stock coal near the shaft, so that the underground work may go on for quite a while if, for lack of railroad cars or any other reason, the hoisting is suspended. The roof in most of this mine is excellent, giving a splendid opportunity to work machines to advantage. All entries are driven double, with a haulage road in each. Bottom is lifted to give the necessary height, the coal being from three to three and a half feet in height. All rooms are double, 50 feet in width, started from the entries with two necks, and having a road on each side, with a gob in the middle. This insures the passage of the air current around the face. The ventilating current is made into seven divi-

sions, with regulating doors so arranged that, if necessary, two or more of them can be turned into any part of the mine. By this means much of the evil from continuous shot firing is avoided, and if smoke is troublesome in any part of the mine, an increased current soon sweeps it out. Keyes' Automatic doors are used on the main haulage ways, and to force the air into rooms old-style hinge doors are placed in convenient places when necessary. When inspected October 27th it was in all respects a model mine. Ventilation is provided by a Crawford & McCrimson blowing fan 20 feet in diameter, which, at a speed of 60 revolutions per minute, discharges 72,000 cubic feet of air per minute into the mine. This is well distributed through the entries and air courses of the mine. The plan of the mine is by P. J. Mooney, Mining Engineer of the company, and the mine has been worked out under the superintendence of Robert J. Wallace, and both deserve credit for its success.

BRAZIL BLOCK COAL Co.'s No. 10 MINE.

Only a few men have been working in this mine at any time during the year, not enough to bring it within the law; consequently it has not been inspected.

BRAZIL BLOCK COAL Co.'s No. 11 MINE.

Located on the Coal Bluff Branch of the C. & I. C. Railroad, southwest of No. 8. This mine was opened in 1896, but no top nor bottom was taken to give the necessary height to use mules. The coal was brought to the bottom by pushers. About the 1st of March it was closed down, and no more coal was taken out until Sept. 1st. When inspected October 12th nothing had been done in the bottom vein. This shaft is equipped to handle a large output of coal. The cages are self-dumping. Two fans are used, one at the main and one at the escape shaft, each 14 feet in diameter. The airway is partitioned from the stairway in the escape shaft, and this is very freely used by the workmen in entering and leaving the mine. It is in splendid condition. The coal lies fairly level in this mine, giving fair grades for haulage. The roof is very dangerous, being a shale cut into large irregular blocks, which fall with very little warning. Several accidents have occurred in this manner during the year in this mine. There was but little work being done on the west side of the mine, as the roof was so bad that it could not be made safe to work under.

HARRISON MINE.

Located on a branch of the E. & I. Railroad, three miles southeast of Clay City. The mine has run very irregularly during the year. The coal lies irregularly, which makes drainage difficult and makes the haulage roads bad. The air courses have not been kept clean, and are choked with mud and water. In spite of these disadvantages a fair current of air was found in all the working places, but there was only half the number of men at work that could be employed in the mine. I am inclined to think that with a full force of men the ventilation would be found insufficient. The coal is of the character known as semi-block, the roof of gray slate and the bottom of fire clay. Charles Nash is in charge of this mine, and is also sinking a new shaft for the same company, and no pains are spared to keep traveling ways and working places well timbered. t

BRIAR HILL MINE.

On the main line of the E. & I. Railroad, one mile northwest of Clay City. This mine has been an annoyance to Mine Inspectors for years. A great deal of water comes into the mine from an overlying bed of quicksand, which softens the underclay, and, unless pillars are left very strong, allows the roof to break or the bottom to "heave," in either case making work in the part of the mine where it occurs either impossible, expensive or extremely dangerous. This has caused an abandonment of all works opened prior to the fall of 1896, and developments made since then by A. L. Boore, who has charge of the mine, have kept these facts in view, and pillars are being left sufficiently thick to bear all weight which can be expected to be thrown upon them. Roads are in good condition. There are numerous "pots" in the roof, which are liable to give way without warning and with but little indication of their presence. Several accidents have occurred from this cause during the year, one of them fatal. The ventilation on my last visit was in good condition. Air courses were opened sufficiently that persons could walk through their whole length. In some places there was more dirt thrown into breakthroughs than I like to see, but in all respects they were all that the law requires, and the air was sufficient for a great many more men than were at work. The underclay from this mine is sold for the manufacture of Terra Cotta ware and encaustic tile, that commands a good market.

PRATT MINE.

Located about two miles west of Perth on the Big Four R. R. This mine is owned and operated by the Coal Bluff Mining Co., of Terre Haute, Ind. It was opened in July, 1888, and is worked exclusively as a hand mine. An attempt was made some years ago to work it as a machine mine, both Harrison and Legg machines driven by compressed air being used, but without success. A twelve-foot Crawford and McCrimmon fan is used to ventilate the mine and produces a good current of air, which is well conducted to the working places, though there is a great deal of old work between the air shaft and the present workings. The coal is the upper vein of block coal and is reached by a shaft 119 feet deep; the coal is $4\frac{1}{2}$ feet thick and has a good black slate roof. Rooms are driven 20 feet wide, with pillars six to nine feet in thickness. The coal from the pillars is recovered after the rooms are worked out. This mine was idle a great deal during the year, and it was not found working on either of my visits.

GLADSTONE MINE.

Is located on the Coal Bluff branch of the C. & I. C. R. R. near the line between Clay and Vigo counties. The lower vein of block coal is worked, which, however, is not of as pure a quality as further east, being somewhat of the nature of the semi-block found in the vicinity of Clay City. The roof is usually good, but in some places it is a flaky, sandy shale, which is very difficult to secure by timber. As it falls in thin sheets, however, it cannot be considered dangerous, and no accidents have been reported from this cause at the mine. The air courses which are not used as hauling roads had become badly choked by dirt from this cause, and have required a good deal of work to open them up this year. This work was the more necessary as the mine generates a quantity of firedamp in some places. The quantity of water had increased so much in the spring of 1897 as to emphasize the necessity of a better means of escape than was furnished by the old escape shaft, and an escape has been sunk at an elevated part of the workings, so that a sure means of egress would be given if water should rise so that the shaft and old escape-way should be shut off. On my last inspection, made October 21st, the ventilation of the mine was found in fair condition except in some rooms where impure oil was being used. On a later visit made by my assistant he reported that this had been remedied.

CRAWFORD No. 2 MINE.

Located near Center Point on a branch of the T. H. & I. R. R., owned by the Crawford Coal Company, W. W. Risher, Superintendent. This has been one of the best mines worked in the block-coal field for many years. It is operating the lower vein, and has had good top throughout. The coal is very regular in height, about three feet nine inches, and the shaft being sunk in the lowest part of the territory, drainage has given but little trouble. Roads have been dry, and the grades being all in favor of the loaded cars, gave it a great advantage in hauling over other mines in this district. On every occasion when this mine has been examined it has been found in excellent condition in all respects. Pillars are being drawn now preparatory to abandonment. It will probably be finished during the present year. The company are making preparations to sink another shaft in this vicinity during the coming spring.

CRAWFORD No. 3 MINE.

Located two and one-half miles northeast of Asherville, on the Center Point Branch of the T. H. & I. R. R. This mine was opened in 1896. It has had a very soft roof in a greater part of the work, as the territory goes to the outcrop of the vein in all directions. Good care has been taken by the mine boss to secure the working places and traveling ways, and but few accidents have occurred from falling roof. The mine has always been found in good condition when inspected. This mine will be worked out and abandoned within five months from January 1st, if present calculations do not miscarry.

WORLD'S FAIR MINE.

Located one and one-fourth miles northeast of Brazil, on the T. H. & I. R. R. Owned by the D. H. Davis Coal Co. Has been in operation very irregularly for several years. The coal is the average height and quality of block coal, and for the most part has a good roof. In some parts, however, the roof is a gray shale, badly cut up with slips, and requiring great care to prevent accidents. Under the circumstances these have been very few, which speaks well for Mr. Robt. F. Jenkins, who has charge of the mine, and for the character of the men employed there. Several times during the year complaint was made of the scales used at this mine, but on only one occasion were they found

working badly. On that occasion they were promptly attended to when the attention of the mine boss was called to their condition. The original territory of this mine is pretty well worked out, but two entries are being driven to test another piece of land recently acquired by the company. Should this prove good, the mine will probably last several years yet, but at present the prospects are very unfavorable. The mine has usually been found in good condition, but on the last inspection several rooms were found where the air was bad, without any chance to remedy it until the places are nearly finished. As this would be shortly and the men working the place requested it, I permitted them to be driven on. Each of them would probably reach their limit in six days. With this exception the mine and its equipments were in good condition.

DIAMOND NO. 3 MINE.

Located one mile south of Perth; is reached by a switch from the main line of the C. & I. C. R. R. It is owned and operated by the Diamond Block Coal Company, of Chicago. During the year the shaft at this mine has been sunk to the lower vein of coal, and some development has been made in it. The distance between the two veins is 25 feet. The roof is hard over the bottom vein, and the coal about three and a half feet thick, but very hard to mine. The coal is reported to be of excellent quality. When last inspected this mine was found to be in good condition, all provisions of the law being fully complied with. This mine is now in charge of James Cuthbertson, Sr., one of the oldest mine men in Clay County, which is an assurance that it will be kept in good condition if that is possible.

EXCELSIOR MINE.

Located about one mile northwest of Perth, on the Coal Bluff Branch of the C. & I. C. R. R. The upper vein at this mine has been worked out, and was abandoned during the year. The vein now being worked is very irregular in thickness, ranging from two feet ten inches to three feet eight inches. Both top and bottom are fairly hard, giving good haulage roads and safe traveling ways in all parts of the mine now at work. The shaft is located on the bank of a branch of Otter Creek, and the former operators mined the coal from under the bed, and did not secure the roof properly. This has caused a great deal of trouble from water, and on two occasions the mine has been flooded. By the carefulness of H. B. Ehrlich, manager, however, all the workmen have been warned in time to escape. This part of the mine has been secured by timber and packing till I think it is safe.

SUPERIOR MINE.

One-fourth mile west of Turner, on the main line of the T. H. & L. R. R. Is owned and managed by Peter Ehrlich, the oldest coal operator in the State. The coal is bituminous, of good quality, and from six and a half to seven feet in thickness. This mine has usually been found in good condition, both in respect to ventilation and safety, as far as could be seen. Some apprehensions have been felt owing to the nearness of the works of several abandoned mines, but a survey shows that there is a sufficient pillar to prevent danger. There are two escape shafts communicating with different parts of the mine, and ventilation is provided for by a fan and furnace. On my last inspection the air was being well circulated around the mine. The location of the shaft makes drainage and haulage difficult and roads hard to keep in repair.

EUREKA No. 2 MINE.

One-fourth mile east of Carbon, on the Big Four Railroad, owned and operated by the Eureka Block Coal Company, of Terre Haute. Both of the principal veins of block coal are worked in this mine. The lower vein varies in height from two feet ten inches to four feet six inches. The roof is good in this vein, but the coal lying uneven makes drainage difficult, and a good deal of water lies on the road in places. This also interferes with haulage. In the workings of the upper vein the roof is bad and the bottom is soft. Hauling roads require to be closely floored or corduroyed, and a great deal of timber is required to make them safe overhead. Air courses become blocked by falling slate, and this renders ventilation very difficult, even with two fans running. On nearly every occasion when a regular inspection has been made at this mine the ventilation in the upper vein workings has been found deficient. On making his last inspection Mr. Epperson found it necessary to order some improvements in this direction, and also in one or two places in the bottom vein. A special inspection will be made soon to learn whether his instructions have been followed. As all the coal from No. 1 mine is now being brought out through this opening, the work extends over a large territory, and a great deal of work is necessary to keep the mine in good condition.

A new mine, to be known as No. 3, has been opened by this company during the year, further east, but as it has but recently begun producing coal, it has not been inspected during the year.

MONARCH MINE.

Located on territory adjoining the city of Brazil on the northwest. This mine is owned by Goucher, McAdoo & Co., and is operated by them solely to supply material for their sewer-pipe factory. During the year about 15 men have been on two turns in order to avoid prosecution for failure to provide a second outlet. With the exception of this failure I have at all times found the mine operated in full compliance with the law. Material is taken out of both top and bottom—shale and clay—for use in the factory, making the workings from nine to ten feet high and giving plenty of room for air to circulate. The mine is always well timbered, and I have never had occasion to call attention to dangerous roof. A change of superintendents during the year is given as the cause of failure to provide a second outlet, but the present manager, Mr. George Goucher, assures me that one shall be provided early in 1898.

BRAZIL MINE.

Located two miles northeast of Brazil. Owned by the Jackson Coal Co. Is reached by the Knightsville North Branch of the T. H. & I. R. R. All three veins of block coal are mined here. The bottom vein has had excellent roof and fairly hard bottom. It has been nearly worked out, and on my last visit but few men were working there, and they near the bottom of the shaft. The principal part of the work now being done is in the middle vein. There is a great deal of bad roof in this vein, and the bottom is very wet. Falls frequently occur, making openings from this to the upper vein, and making it very difficult to carry air through the air courses in the middle seam. However, on my last inspection, October 30, I found nearly all working places in this vein fairly well ventilated, and with few exceptions, safely timbered. I called the attention of the workmen to the dangerous ones, and I presume they took proper precautions to make themselves safe, as no accidents have been reported from such places. The works in the upper vein are in good condition, dry and well ventilated. The coal is of good height, but rather softer than the block coal from the regular veins. Very little water is found on the roads and the roof seems to be easily held by timber. No complaints have reached me since my last inspection, and I am informed that improvements have been made in the middle vein and that all are well ventilated.

NICKEL PLATE MINE.

Three-fourths of a mile northeast of the above, and owned by the same company; is nearly worked out. Two veins have been mined here. The lower vein has nothing but entry pillars left, and those only where it is necessary to support the work that is to be done in the upper vein. For a mine that is so nearly completed it is in good condition. In some places there is a very weak current of air, and in others a great deal of black damp is given off from old works, but sufficient fresh air is supplied to dilute it and render it comparatively harmless. It is thought that it will be abandoned in about six months. In work of this character there is always great danger from falling roof. Accidents can only be avoided by the highest degree of care on the part of all concerned. I think this is being exercised by most employes at this mine, and I hope the mine will be finished without mishap.

MARKLAND MINE.

Formerly known as the Burger mine, located at the north limit of Clay City, is now operated by Andrews & Burnham, who are rapidly developing it. When inspected on November 4th 31 men were employed, with a daily output of 100 tons. The coal is from three to four and a half feet thick and of excellent quality. The law is being complied with in all respects, except that no second outlet is provided. Permission was given to run until spring without one, though more than 5,000 square yards have probably been excavated. Yet so much of the older works have fallen in that it would be very difficult to prove the fact. A surveyor could not get through nor around this part of the mine. The proposed plan is to sink a larger shaft for hoisting, and use the present opening for an escape way. This will probably be done.

FAIRVIEW MINE.

Located on the C. & I. C. Railroad, four miles northwest of Brazil. Two veins of coal are mined. This mine has always been found in good condition when inspected. While the upper vein has all the drawbacks and dangerous features commonly found in this seam, no accidents have been reported as caused by falling roof or coal at the mine during the year. The mine is operated by the Otter Creek Coal Company, of Brazil, Ind. The Nellie mine, near Brazil, operated by the same company, was abandoned during the year.

SAN PEDRO MINE.

Located north of Staunton, on the T. H. & I. R. R. Owned by Joseph Somers. This mine has been operated very irregularly during the year, and was inspected but once—December 10—and was found in good condition. The coal is bituminous, seven feet thick, and of good quality.

LOUISE MINE.

One and one-half miles north of Center Point; operated by the Weaver Coal Company. This mine has not been operated with any regularity for the last two years; in fact, it has not run long enough at a time to enable the managers to put it in good condition before another shut-down. This is one of the few mines in this State that have been developed on the single-entry plan. As a result of these two drawbacks the mine was found in bad condition when last inspected—December 13. However, but very little work was required to make it fairly good, and orders were given to have that done before the close of the year, and the changes were begun immediately, with a promise that they would be pushed to completion as soon as possible.

BRIAR HILL MINE.

Located at Asherville, on the Center Point Branch of the T. H. & I. R. R. Owned by Zeller, McClelland & Co.; was idle from May 1st till the latter part of September. It is now being operated with a view to its final abandonment early in 1898. When examined, December 13, it was found in fair condition for a mine where only pillar work is being done.

COLUMBIA No. 4 MINE.

Located one and one-fourth miles southwest of Asherville, owned by the same company, was opened in 1896. It is being operated in the upper vein of block coal. The roof is very bad, even for this vein; and requires a great deal of timber and attention, making it difficult to make it secure. The main north entry is now standing in a very large fault. The mine is in fair condition, with a few exceptions, and efforts are being made to better those parts of the mine. The shaft at this mine will probably be sunk to the lower vein later. Several serious accidents have occurred here from falling roof during the year.

VICTORIA MINE.

Located one-half mile west of Cardonia, on the C. & S. E. Railroad. This is an old opening with a new name. It was operated by the Clay Coal Company in 1873, and by several other parties since then. The lower vein of block coal is being mined. The coal is brought to daylight through a drift, and is hoisted by a gin operated with horse power to a height of about 20 feet and dumped into railroad cars. While the mine has been operated so long there seems to be a considerable body of solid coal in the territory reached, and the mine may last quite a while. There are about 30 men employed, or were when the last inspection was made. The mine is operated by Allais & Urbain, Brazil, Ind. It is ventilated by a furnace which produces a sufficient circulation of air in all parts of the mine, and the roof is good.

DAVIESS COUNTY.

CABLE NO. 4 MINE.

Located on a branch of the B. & O. S. W. R. R., near Washington, Ind., owned by Cable & Co. Was opened in 1885; has a capacity at present of 330 tons daily. It is opened by a shaft 42 feet deep, and the second outlet is by a slope, and no men or mules are supposed to be hoisted at the shaft. This rule, however, is not strictly observed. The coal lies very uneven, giving considerable grades over which it has to be hauled, and making drainage troublesome, though it is fairly carried out. The bottom is fire clay and, where water is permitted to stand on it, works very easily into mud. A very good gray shale roof overlies the coal, and it is well timbered where it is necessary. The coal that is now being worked is bituminous, about 2 feet 10 inches thick, of good quality. Double entries are driven 7 feet wide, with a pillar 20 feet in thickness between the pair of entries. The bottom is taken up to make the roadways 5 feet high. This gives an area of 7 feet by 5 feet for the principal air-ways. They are kept fairly clean, and afford a good passage for air currents. The ventilation is produced by a fan at the main shaft, which gives a good supply of air, but doors and stoppings allow a good deal of it to escape before reaching the working places. However, on the last inspection, all working places were found well ventilated. Pillars are nearly all saved.

CABLE No. 9 MINE.

Located on the same branch railroad as the above, some distance west; it is owned by the same company. This mine was opened in 1892. During the summer of this year an electric plant has been installed, and at present two Morgan-Gardner mining machines are in use. The capacity is 125 tons per day. The conditions are about the same as at number four, except that a band of draw slate from 2 to 20 inches in thickness is found above the coal, and the height necessary for entries is taken from the top instead of the bottom. The escape way is by a slope 700 feet from the bottom, which is used almost exclusively by men and mules.

Ventilation is produced by a ten-foot fan at the main shaft, and a good current of air is produced, which is nearly all carried to the working places. The size of the air compartment of the shaft is $7 \times 8\frac{1}{2}$ feet, and the principal air-ways are 8×5 feet in section. The miners here came out on a strike on May 1st, owing to a dispute about handling the dirt made by the draw slate which is spoken of above, and the mine was idle until August 1st, when it was started with colored men imported from Kentucky. A number of the old miners have left the place, but some are still insisting that the strike is being continued.

MONTGOMERY No. 1 MINE.

Located on the main line of the B. & O. S. W. R. R. at Montgomery; it is operated by the Daviess County Coal Company. No men are hoisted at the shaft, as there is a good outlet by means of a slope 200 feet from the shaft. The capacity of the mine is 300 tons per day. The hoisting shaft is 85 feet deep, $18 \times 7\frac{1}{2}$ feet in size, with an air compartment $4\frac{1}{2}$ feet wide cut off one end of the shaft. The coal is a good quality of steam coal and is about 4 feet thick, with a thin dirt band near the middle. Rooms are driven 22 feet wide, with pillars 12 feet thick between them. About half of them are saved. Grades are irregular and bottom soft, making it difficult to keep hauling roads in good condition. A 10-foot fan furnishes ventilation for the mine, and does the work very well. The company is sinking another shaft about one mile west of No. 2, the No. 1 Mine being so nearly worked out there will be nothing but pillars to draw by next Spring.

MONTGOMERY No. 2 MINE.

Located near the above and owned by the same company. It was opened in 1896, and is connected with No. 1 Mine for a second outlet, and has a present capacity of about 150 tons per day. The shaft is 65 feet deep, and conditions are about the same as in the case of No. 1. An 8-foot fan at the main shaft furnishes sufficient ventilation. Both mines are under the superintendency of Geo. B. Brown, and the methods of working are so nearly alike that no further comment is necessary here. Coal is furnished to the engines of the railroad, 14 pockets having been constructed for that purpose.

MUTUAL MINE.

Located three-fourths of a mile south of the B. & O. S. W. Railroad, near Clark's Station. It is owned by the Mutual Mining Company. The coal is hauled by mules from the shaft to the tip-house on a tram road, one mile in length. The tippie is at the railroad, and the coal is loaded there into railroad cars. The production is 200 tons per day at present. The escape is a shaft 600 feet from the hoisting shaft. The depth of the shaft is 100 feet to the vein that is now being worked. Another vein lies above this, but it has never been worked here. It is from $3\frac{1}{2}$ to 4 feet in thickness, but has not a good roof. The vein now being worked averages about $4\frac{1}{2}$ feet in thickness, two-thirds of which is cannel coal, and the other one-third an excellent quality of bituminous. The vein lies nearly level, and has a good roof generally, though some bad places are found. The mine is well drained and the haulage roads are good, and are laid with 12-pound iron. Entries and air-courses are 8 feet wide, with pillars from 12 to 14 feet thick, and require no timbering. Rooms are driven 24 feet wide, and pillars 12 feet thick are left in such a condition that nearly all the coal will finally be saved, the rooms being well timbered, and the road placed near the pillar side. Ventilation is provided for by a 12-foot fan at the escape shaft. A good current of air is found at the faces of all entries, and all the working places, for safety and ventilation, will compare favorably with those of any mine in the State of Indiana. This mine was opened in 1884.

HAWKINS MINE.

Is located on the E. & I. Railroad, near Washington, and is owned by the Washington Coal Company. Its production is 100 tons daily. The second outlet is by a shaft 100 feet from the main opening. This is a shaft 64 feet in depth. The bottom is soft, but well drained, and a good haulage road is kept up. The track is all wood, and turntables are used instead of partings. The coal is 6 feet in thickness and is a good quality of soft coal, with no dirt bands in the seam. The roof is a soapstone, and entries and air-courses are driven only 6 feet wide, and timbered. Air-courses are kept clean and well drained. Rooms are 16 feet wide, with pillars 10 feet thick, which are nearly all saved before the workings are abandoned. A good road is maintained to the escape way. A fan 10 feet in diameter, located at the escape shaft, furnishes the air necessary to ventilate the mine. A good current of air is maintained at the faces of all entries, and the mine generally is in excellent condition.

WILLSON'S NO. 4 MINE.

Owned by the Washington Coal Company; it is located near the town of Washington, and is operated to supply local trade. It was opened in 1894. A gin hoist is used with a chain instead of a rope. The mine has, at present, a capacity of 50 tons per day. The mine is driven through the hill, thus affording two outlets, on opposite sides of the same. It is opened by a slope 100 feet long, and depends on natural ventilation for air. The vein is $3\frac{1}{2}$ feet in thickness, of excellent soft coal, with a good shale roof and fire-clay bottom, and, while it lies irregularly, is well drained, and good roads are kept up. It is worked in such a way that all coal is saved. Timbering both in rooms and entries is well looked after. When inspected, December 22, a fair current of air was circulating in the mine.

RAGLESVILLE COAL CO.'S MINE.

Located one mile east of the town of Ragsville. It is operated by the Ragsville Coal Company, U. G. Stoy manager. The mine is opened by a shaft 36 feet deep, and the coal is hoisted with a gin operated by horse power. Coal is taken from the mine by wagon, the principal market being found in the immediate vicinity, though some is hauled to the E. & R. Railroad, a distance of three miles, and shipped

from there. The vein is about 3 feet thick, with good roof and fairly hard bottom. No animals are employed, the coal being brought to the bottom of the shaft by pushers. This mine was opened during the year 1897, and was in good condition when inspected, November 27th. There were 24 men employed on that date.

UNION MINE.

Located one and one-fourth mile southeast of Raglesville. It is operated by the Union Coal Company; is a drift opening made in 1896. One mule is used in this mine, and, with this exception, the remarks made in regard to the Stoy Mine will apply to this. Sixteen men were employed November 27th, and the mine was in good condition.

CO-OPERATIVE MINE.

Located one and one-half miles southeast of Raglesville. It is operated by the Co-operative Coal Company; is a drift mine, opened in August, 1897. No screens are used, but the coal is cleaned in the mine by the use of riddles. The roof is good, and no timber is used in entries or air-courses, and to this time no falls have occurred to interfere with the course of the air, and the mine is in good condition at present. Ventilation in each of the above is by furnace.

FOUNTAIN COUNTY.

INDIANA BITUMINOUS MINE.

Located west of Silverwood, Indiana, on the Clover-Leaf Railroad. It is operated by the Indiana Bituminous Coal Company, of Terre Haute; R. S. Tennant, President. It was opened in the fall of 1894. By reason of its location a good market has been found for its product, and it has been operated more steadily than any other mine in the State since it began shipping coal. It is equipped with self-dumping cages, and has a capacity of 600 tons per day. The coal is of a good quality of bituminous and seems to give satisfaction wherever it is used. The coal is very irregular in thickness, running from 4½ to 7 feet, and has very great changes of level, requiring a great deal of grading to secure good haulage roads. The under-clay makes a good quality of brick, and has a fair demand for this purpose. The mine has usually been found in fair condition when examined, though an improvement could be made in the quality of oil that is used for light, which makes a great deal of smoke.

STURM MINE.

Located near Silverwood, on the Clover-Leaf Railroad. While this mine has been opened some time, it has been operated on a small scale until this year, when it passed under the control of the Silverwood Coal Company, who are now working about 25 men, and producing 50 tons of coal per day. The underground works of the mine are in good condition, and the ventilation is excellent. A few minor provisions of the law in respect to the equipment of the mine were not complied with when the mine was inspected, but they will be soon. The shaft is 51 feet deep.

DUBOIS COUNTY.**HUNTINGBURGH MINE.**

Owned by L. B. Southard, Huntingburgh. It is located on the branch of the Air-Line Railroad, near the town. It was opened in 1886 and has been operated ever since, mostly, however, in a small way. The shaft is 35 feet deep. Very little attention was being paid to the mining law, and many recommendations were needed. There has not been a second visit made to see whether they have been complied with or not.

GIBSON COUNTY.**OSWALT MINE.**

Located one mile north of Princeton, at the crossing of the E. & T. H. and the Air-Line railroads. It is operated by the Maule Coal Company, of Princeton, Ind.; it is opened by a shaft 440 feet deep. A second outlet has been completed at this mine during the year, and a good hoisting arrangement has been placed at the air-shaft. This has a separate engine, which is supplied by steam from the main boilers. The surface plant of this mine is one of the best in the State, having a double hoisting engine, with 18x32-inch cylinders coupled direct to a drum 8 feet in diameter. The coal is screened over perforated steel plates for the larger size, the screenings being elevated and passed through a revolving screen with meshes of three different sizes. The whole screening plant is operated by an engine,

with a cylinder 10 inches in diameter with a 20-inch stroke. Seven different sizes of coal are made. Ventilation is produced by a fan 12 feet in diameter, which produces a good current in the mine. The shaft is very wet, but in other respects is in a good condition. The coal is a very hard bituminous, from $6\frac{1}{2}$ feet to $7\frac{1}{2}$ feet in thickness. Entries and air-courses are driven 8 to 9 feet wide, giving a large area for air travel. While considerable fire-damp is generated in some parts of the mine, no accidents have occurred from this cause during the year. Part of the coal is mined by hand and part by machinery. The Yoch mining machine, driven by compressed air, is used.

GREENE COUNTY.

ISLAND NO. 1 MINE.

Located one and one-half miles south of Linton, on the I. & V. Branch Railroad. It is the pioneer mine of Greene County, having been the first of any consequence opened in the county. It was opened in 1883 and worked as a pick mine until 1892, when the company equipped it with the Harrison compressed-air machines and a rope haulage about 1,200 feet in length. The mine is also equipped with the shaker screens, which are found to be very effective in removing all the fine dirt or slack, and making a very desirable grade of lump coal. They have also put in the improved Prox & Brinkman self-dumping cages. The capacity of the mine at present is 600 tons daily, giving employment to 100 men. When last inspected it was found necessary to order several changes in the mine to secure better ventilation, which was not good in some parts. This the company readily agreed to do. The depth of the shaft is 66 feet, and thickness of coal, as was given in the 1896 report, is 5 feet.

ISLAND NO. 2 MINE.

Located at Linton, one-half mile west of the town proper; it is worked by a shaft 95 feet deep. This is one of the most favorably situated mines in Indiana, as to railroad facilities, having a double tipple, one on the main line of the I. & I. S., and the other on the I. & V. Branch R. R. The advantages of location are two-fold; first, their ability to secure empty cars from either line, and that of sales and shipments on both roads. The mine is equipped with the Harrison machines, 25 in number, and has a rope haulage on the south

side 2,200 feet in length, while the coal on the north side is hauled by mules, some of it a distance of 4,000 feet. The daily output at present is 1,200 tons. The coal, as has been previously reported, is 5 feet in thickness, and of excellent quality for steam and domestic purposes. I have made two visits to this mine during the past year, and at both inspections found the mine in excellent condition.

ISLAND VALLEY MINE.

Located two miles southeast of Linton, on the I. & V. Branch Railroad. It was opened in 1892 by a joint stock company, composed principally of miners, and has been one of the most successfully operated mines in Greene County. It is worked by a shaft 52 feet deep, and has an excellent vein of bituminous coal 5 feet in thickness. The daily capacity at present is 350 tons, giving employment to 58 miners. When last inspected, an overcast was ordered put in on the west side, to assist the ventilation in that part of the mine, which was very poor at that time. This the company did, and the mine is now fairly well ventilated.

FLUHART MINE.

Located one and one-half miles southwest of Linton; it is worked by shaft 72 feet deep. This mine was opened in 1891 and ranks among the largest pick mines in Indiana. The output at present is 800 tons daily, giving employment to 120 miners. This, however, is not its full capacity, owing to an insufficient number of miners to do the work. The mine is well equipped with improved screening machinery, also a number of coal bins for storing small coal. The coal is 5 feet thick and of excellent quality. When last inspected it was found necessary to request the air-courses to be cleaned out, and the brattice replaced in the main shaft to assist the ventilation, which at that time was poor in some parts of the mine. The company promptly complied with the request, and the mine is now in fair condition.

SOUTH LINTON MINE.

Located one mile south of the town proper of Linton. This is a pick mine, worked by a shaft 81 feet deep, and was opened in 1893. It has a vein of bituminous coal 5 feet thick, and of excellent quality for steam and domestic purposes. This is one of the best regulated mines in Indiana. I have made two inspections of it during the past

year and at each inspection found it in excellent condition, the law being complied with in every particular. The daily capacity at present is 400 tons, giving employment to 66 men.

SUMMIT MINE.

Located one mile west of Linton. It is very favorably situated as to railroad facilities, having two switches, one from the I. & I. S. and the other from the I. & V. R. R.; thus giving it excellent shipping facilities and the additional advantage of securing empty cars from the two roads. This is one of the largest pick mines in Indiana, having a daily capacity of 750 tons, and employing 125 miners. It is worked by a shaft 95 feet deep and has an excellent vein of bituminous coal 5 feet 4 inches thick. This company suffered a very considerable loss in the early part of last March, owing to the heavy rainfall which flooded the mine and caused the man-way to cave in, which, when cleaned out and stairway replaced, cost several hundred dollars. At the last inspection the mine was in a fair condition.

TEMPLETON MINE.

Opened in 1892. This mine is situated within the corporate limits of the town of Linton, and about three-fourths of a mile from the town proper. It is located on a branch of the I. & I. S. R. R. It is a pick mine, worked by a shaft 52 feet deep, with a vein of bituminous coal 5 feet thick. During the past year the mine has been materially developed. One year ago about 40 men were employed, with a capacity of 250 tons per day, and there are now employed 112 miners, with a capacity of 750 tons per day. I have made two inspections of the mine during the past year. On the last inspection it was found necessary to order some changes made to promote ventilation, which order was promptly complied with, and the mine is now in good condition. Among other improvements made, with a view to the safety of the mine within the last year, there has been an escape shaft sunk and equipped with a stairway, as provided by the law.

KNOX COUNTY.

BICKNELL MINE

Located at Bicknell, on the I. & V. Railroad. At present it is operated by the Bicknell Co-Operative Coal Company, and is opened by a shaft 97 feet deep, sunk in 1890. The present production is about 140 tons per day, of a fair quality of bituminous coal. The roof is good and no timbering is required in the narrow work. The mine has always been found in excellent condition when inspected.

EDWARDSPORT MINE.

Located one mile northeast of Edwardsport, on the I. & V. Railroad, and is operated by the Edwardsport Coal Company of Indianapolis, Ind. The opening was originally made in 1894 by a slope, and the coal was brought to the dump by mules. During 1896 a shaft 45 feet deep was sunk and the coal is now brought out by that opening, the slope being used for an escape way. The mine is in excellent condition, except that at the point where the shaft was sunk the coal had been previously mined. This makes the pillar very weak at the bottom of the shaft, and may cause trouble in the future. However, every possible precaution has been taken to prevent this by putting in heavy timber, and it is likely to stand for years. The present output is 175 tons per day, of excellent bituminous coal. The vein contains two thin veins of clay near the middle of the coal, but the dirt is easily separated. No timber is used in the narrow work, and the air-courses are not kept clean, but a good current of air is kept in circulation. This is produced by a fan at the main shaft. The tibble is located 530 feet from the shaft, and a gravity plane is used to take the coal from shaft to the tibble.

PROSPECT HILL MINE.

Located near the city of Vincennes. It is operated entirely for local trade, having no shipping facilities. This mine has given us a great deal of trouble during the year, owing to the fact that it had no second outlet. An escape shaft had been begun some years since, but work on it had been abandoned and the mine worked with such a small force of men that its completion had never been undertaken. The experience of 1896 convinced the manager, Mr. F. Clarke, that to make the mine profitable more men must be employed, and he let a contract early in the Summer to have the escape-way completed. The contractor failed to do the work, and finally men were employed by the day, and the work was completed about December 1st. On several occasions we were informed that more than ten men were being employed in the mine at one time, and, on August 4th, we found nearly twice that number. On the promise of the manager that the offense would not be repeated, we did not prosecute the company for this violation. As far as we have been able to learn, the promise was kept, and two shifts of men, working night and day, kept the

trade supplied. The probabilities are that this mine will be developed considerably during the year 1898, as means of ventilation and hoisting facilities will be greatly improved by the opening of the second shaft.

MARTIN COUNTY.

THE BEDFORD COAL COMPANY'S MINE.

Located at Tunnel Switch, on the E. & R. Railroad, is the only mine in this county employing over ten men. It is a drift opening, and has natural drainage; no steam power is used about the mine. The coal is of excellent quality, and has good roof and hard bottom, requiring very little timber. The vein is from 30 to 36 inches thick. Ventilation is produced by a furnace, and, while the current is not strong, working places were all found to be clear when inspected, November 26th. There are two other veins showing in the hill where this mine is located, both of good quality, but are thin—22 and 28 inches, respectively.

OWEN COUNTY.

LANCASTER NO. 4 MINE.

Located near the west line of Owen County, about three miles east of Clay City. It is operated by the Lancaster Coal Company, of which John Andrews, one of the first operators in the block coal field of Indiana, is President. The mine is connected with the E. & I. Railroad by a switch three miles in length. Its present capacity is about 100 tons per day. The coal lies near the surface, the shaft being but 20 feet deep. It is a hard coal, of good quality, and is known as the semi-block, as is all coal in the vicinity of Clay City. In thickness it is from $3\frac{1}{2}$ feet to 5 feet. Being so near the surface, the roof is soft and requires a great deal of timber. In spite of this fact, the mine is in good condition, the air-ways being kept clean and a good current of air being circulated. This is the only mine in Owen County within the provisions of the law; and it will not last very much longer.

PARKE COUNTY.**COX NO. 3 MINE.**

Located near Coxville, on the C. & I. C. Railroad. It is owned and operated by the Brazil Block Coal Company, of Brazil, Ind. The equipment of this mine for handling coal and preparing for market is the best in the State, being fitted with a screening and washing plant, which is described at length in another part of this report. The coal is mined by machinery. Twenty-one Harrison and one Ingersoll-Sergeant machines are used, driven by compressed air. Two Norwalk compressors, each of 125 horse power, are a part of the plant. The coal is of the average quality of the "L" seam, as found in different parts of this State. It averages 6 feet in thickness, separated into two strata by a clay band from 2 to 4 inches in thickness. This gives a good height for haulage-ways and air-courses. The roof consists of a gray shale, which falls in slabs when acted upon by air current. This makes it very expensive and difficult to keep traveling roads and air-ways safe, but no accidents to persons have been reported as having occurred from unsafe roof in such places, which speaks well for the management. Ventilation is provided for by two fans, one at the main shaft and one at the No. 1 shaft of the company, which is located 1,200 feet from No. 3, and is used as an escape-way for the present works. A good current of air is maintained in all entries, and all working places are clear. No recommendations were necessary when the mine was last inspected.

OTTER CREEK MINE.

One mile northwest of Carbon, on a switch constructed from the Big Four Railroad. It is operated by the Brazil Block Coal Company. The works at present are in the upper vein of block coal, which is reached by a slope, and lies above water level. The bottom vein was reached by a shaft here, but this is now filled with water and has not been used for over two years. The roof in the vein now being worked is very bad, as a general thing, and as the bottom is a soft clay, and a good deal of water is found in the mine, plenty of timbers are needed to keep the entries and air-courses open. This is being accomplished in such a way as to prevent accidents and keep the mine well ventilated. But little work has been done here during the year 1897.

LYFORD NO. 2 MINE.

Located near Lyford Station, on the C. & E. I. Railroad. It is operated by the Calumet Coal Company, of Chicago, Ill.; has been open for several years, but has been idle a great deal of the time. Since the beginning of this year this mine has run as steadily as others in the bituminous district of this State. It is equipped to produce a large output, having a railroad track on each side of the shaft, with a full outfit for the handling of coal on either. Since starting this year, however, self-dumping cages have been put in, which are available only on one side. The present output is about 500 tons per day, which is mined by seven Harrison machines, operated by compressed air. The escape shaft has been provided with a stairway during the year. The coal is of the same general character as that at Coxville, with like material about $6\frac{1}{2}$ to 7 feet in thickness, and has about 4 feet of gray slate overlying it. This cuts and falls when acted on by the air, until a stone is reached which requires no timber, but as the handling of so much dirt is expensive, different means have been tried to hold it. The only one that has proven successful so far is to leave enough coal to keep the air from the roof. Where this has been tried no breaks have occurred yet, though some of the work has stood a great deal longer than was necessary to show the failure of other plans. If that slate can be kept up, it will greatly reduce the cost of working this vein of coal here and elsewhere. This mine was found to be in good condition in all respects when last inspected. The No. 1 Mine of this company has not been in operation since February, when the shaft tower was burned. It has been rebuilt, but no work has been done underground.

PARKE NO. 8 MINE.

Located one mile northwest of Rosedale, operated by the Parke County Coal Co., of Rosedale, Ind. It is the same coal field as Cox No. 3, and remarks made as to underground condition apply here. This mine has a switch from the T. H. & L. Railroad from Rosedale, and from the C. & I. C. Railroad at Coxville; is equipped with self-dumping cages and has a capacity at present of 500 tons per day; but this could be greatly increased. The coal is mined by Harrison machines, driven by compressed air, furnished by three 125 horse power Norwalk compressors. Twelve machines are in use at present, but 20 more are available when needed. The shaft is 125 feet deep, and coal is

brought to the bottom by a rope haulage of 900 feet in length. The haulage roads and air-courses are timbered where it seems necessary, but where air-courses are not used as haulage-ways, very little attention is given to them, and they are generally found in bad condition, and the ventilation of the mine defective. The escape-way is through No. 6 shaft, which has recently been abandoned as a hoisting shaft. They are 2,100 feet apart. When inspected, December 15th, though the fan was running at a high rate of speed, the ventilation was found to be very defective. I hope to be able to report improvement soon.

MECCA NO. 1 MINE.

Located at Mecca, on the C. & I. C. Railroad. It is operated by the Otter Creek Coal Company, of Brazil, Ind. During the year an electric plant has been installed, consisting of a 30-horse-power dynamo, an electric motor for haulage and a power drill. The motor is not heavy enough for the work that it was expected to do, and is being operated over only a part of the distance it was intended to work upon. On my last visit some work was being done with a view of remedying this. Two veins of coal are being worked at this mine, but the upper vein seems to lie in pockets, and is reached by tunnels at two different points in the mine. The distance between the veins is from 4 to 10 feet, of a rather soft material. This mine has worked quite a distance from the shaft, and the motor is intended to haul coal about 2,600 feet. The roof in the greater part of the mine is so that it is not difficult to keep the roads open, and, with more power, the electric haulage would be a success. There are heavy grades and many curves, however, which require a great deal heavier motor than would be needed on a straight road. The coal in this mine is a hard bituminous, of good quality. It is mined by blasting without undercutting. All the work is done by hand except that accomplished by one electric drill. The output of the mine is about 150 tons per day. The mine is well ventilated in all of the working places. Only one fan is in use, but another is in place and can be put in operation at any time it should be desirable.

CRAWFORD NO. 1 MINE.

Located two miles northeast of Carbon. It is operated by the Crawford Coal Company, of Brazil, Ind.; is a block coal mine, working in both of the principal veins of this character. The bottom vein is reached by a shaft 35½ feet in depth, while the upper vein lies under

the hill to the south of the shaft and is worked through a drift. The total output of the mine at present is 476 tons per day. Each vein is worked independently of the other with respect to ventilation and outlets, each having a fan and separate escape-way. The roof overlying the upper vein seems to be a brittle, hard pan, which, when it is allowed to fall, permits water to run into the mine from the surface, and the cracks do not close themselves, as is usual with the strata which overlies the coal in other places. This makes a great deal of trouble in the mine. In other respects this mine differs but little from other mines in the block-coal district. However, in spite of the fact that it usually runs very irregularly, I have always found this mine well ventilated, and the roadways well timbered and in good condition for hauling coal upon. The last inspection was made by Mr. Epperson, on November 10th, and was no exception to this rule.

McINTOSH MINE.

Located on the Coal Bluff Branch of the C. & I. C. Railroad, three-fourths of a mile northeast of the Brazil Block Coal Company's No. 8 Mine. It is owned and operated by I. McIntosh & Co., Brazil, Ind. The shaft is 127 feet deep to the bottom vein of block coal, the upper vein having been exhausted. The most of the thick coal has been mined, and there is very little being worked in the mine over 3 feet in thickness. The roof is good and the bottom fairly hard, giving good roads generally in the mine. Very few pillars are being removed from the bottom vein yet. The ventilation has generally been found good in this mine, but, on my last visit, several places were found where doors and stoppings are needed to carry the air to the working places. The mine boss promised to remedy this soon.

STANDARD MINE.

One-fourth mile west of the above. It is operated by the Standard Coal Company, of Terre Haute, Ind. Both of the regular veins of block coal are being worked. The coal from the upper vein is lowered by a drop shaft to the workings below, and all the output is hoisted from the same landing. The car service from the C. & S. E. Railroad proved so unsatisfactory that during the year a switch has been secured for this mine from the C. & I. C. Branch, thus giving an outlet by two different routes. The latter switch was not finished on my last visit to the mine, November 9. But little work had been done in the upper vein at that time. The places that were open there were very wet. The bottom was in good condition, well ventilated and safely timbered.

COLUMBIA No. 1 MINE.

Formerly known as Superior No. 1, is located one-fourth of a mile north of the above. This mine is being operated in the upper vein of block coal, has a bad roof, dips and rises are irregular in pitch and direction, and makes a great deal of water. This renders it difficult and expensive to maintain haulage roads and air-courses, and I have usually found the ventilation defective. During the past year, however, a great improvement has been made in this respect, and on my last visit, November 9, I found the ventilation much better than at any previous time. A large part of the mine is being finished, and when this is cut off it will be easier to keep the rest of the mine in good condition. This mine and Columbia No. 2 are owned by Zeller, McClellan & Co., Brazil, Ind.

COLUMBIA No. 2 MINE.

Located one-half mile southwest of the above. It is owned by the same company. It is arranged to ship coal on both the C. & S. E and C. & I. C. railroads, having a separate screening outfit, scales and switch tracks from each road. The capacity is about 400 tons per day. There are no special features worthy of notice in the condition under which it is operated, except that possibly the roof in the upper vein is worse than usual, and a great deal of timber is necessary. The entries are well taken care of, but a great deal of dirt is allowed to accumulate in the air-courses. As the works have not been extended very far yet, a good current of air is being circulated around the regular air-ways, but it does not seem to have force enough to clear out smoke where work is being done any distance in advance of the current. All entries in the top vein were smoky, and a great many rooms where a good current of air was passing the mouths of the room. I think a great deal of this was due to bad oil. I found the bottom vein workings well ventilated and safe.

PERRY COUNTY.**CANNELTON MINE.**

Located three miles northeast of Cannelton. It is operated by the American Cannel Coal Company. The mines have been operated here by this company for many years; in fact, they were among the first opened in this State. The coal lies in the hills above water level. Two of these have been worked out and abandoned; except that a haulage-way is maintained through them, through which all coal that

is mined is drawn by mules. The present works are quite extensive, but there is very little being done now except to remove pillars. Ventilation is produced by a furnace, and this is the only extensive mine in which I have seen this method successfully employed. I found good air in all parts of the mine on my inspection, December 21, 1897. The daily capacity is about 160 tons, eight mules being used. The coal is hauled by mules through the tunnels mentioned above, to the dump, a distance of one and one-fourth miles. It is there dumped into hopper cars, which are taken to the river by a small locomotive, and lowered by a self-acting plane to a tippie and loaded on boats. The greater part of the product is sold for the use of the steamboats. Some, however, is used for local trade in the town, but there are several country mines in competition for this market.

TROY MINE

Located one-half mile above the town of Troy, on the Cannelton Branch of the Air-Line Railroad. It is operated by Bergenroth Bros., and was opened in 1887. The daily output is about 50 tons, which is nearly all sold to boats on the Ohio River. The shaft is 50 feet deep, being sunk most of the distance through a massive sandstone. The roof and bottom are both hard, so that there is but little danger in working the mine. The coal is about 3 feet thick and of a very good quality. Ventilation is provided for by a furnace, which, however, was not in operation when the mine was inspected, on December 21st. There was a good current of air passing through the mine, being produced by natural ventilation between the two openings. The mine was not running on my last visit.

PIKE COUNTY.

PETERSBURGH MINE.

Owned by the J. Wooley, Jr., Coal Company, of Evansville; is located near the south limits of the town of Petersburg, on the E. & I. Railroad. It was opened in April, 1896, but employed but few men during that year. The production is 170 tons per day, mine-run. The shaft is 52 feet deep, and there is about 5 feet of clean coal, of a fair quality. It is driven on a very irregular plan, entries being from 8 to 12 feet, and rooms from 18 to 22 feet wide; this causes pillars to be of irregular thickness, and they are expected to be lost. Ventilation is furnished by a steam jet, which seems to furnish sufficient air for the workings at present. A second outlet will be necessary during the coming year.

AYRESHIRE MINE.

Located on the main line of the Air Line Railroad; is owned by David Ingle, of Oakland City. It is equipped with self-dumping cages and a roller screen to make nut coal from the coal that goes through the stationary screen. The capacity is about 600 tons per day. The coal is hoisted through the shaft, 22 feet deep, and is 5 feet thick of an excellent quality of bituminous coal, with a good roof and soft bottom. Very little timber is needed in the entries, but large pillars are left, containing about one-third of the total amount of coal in the vein. This keeps the roof good and the air-courses open, though haulage roads are muddy. The ventilation is produced by a fan and is good in all parts of the mine. A large proportion of the coal is nut and slack, and miners consider 33 cents per ton for mine-run coal the equivalent of 60 cents for screened coal.

HARTWELL MINE.

Located near Augusta, on a branch of the Air Line Railroad, five miles long. It was built in 1894, when the mine was opened, and is operated by the Cabel & Kaufman Coal Company, of Washington, Ind. It is opened by a drift and has a capacity of 70 tons per day. An electric plant has been installed here during the year, and one Morgan-Gardner chain machine is now in operation. Six mules are used in hauling the coal from the mine. The coal is $4\frac{1}{2}$ feet in thickness, but contains a good deal of impurity in the way of sulphur and dirt. Ventilation is provided for by a small fan, which produces a good current of air. The engine house and tipple were burned during the year, but have been built more extensively than before the fire.

BLACKBURN MINE.

Owned by the S. W. Little Coal Company; is located at Blackburn, on the E. & I. Railroad. There is one of the most complete screening outfits here that is to be found in the State. Perforated plates 12 feet long by 4 feet 4 inches wide are used. For making lump coal the perforations are 4 inches in diameter and the nut coal screen has perforations $2\frac{1}{2}$ inches in diameter. They are so arranged with double eccentrics that all jar from their motion is neutralized. The method by which this is accomplished was designed by Mr. S. W. Little, of Evansville. Space will not permit a full description of the arrange-

ment here. The production of the mine is 300 tons per day. The main opening is a slope 475 feet in length, the coal being brought up by steam power. The escape-way is also a slope 400 feet in distance from the main opening. The grades in the mine are easy, with fairly hard fire-clay bottom, making the maintenance of good haulage roads comparatively easy. The coal is a hard bituminous, $7\frac{1}{2}$ feet thick, with a good black slate roof. Entries are driven from 8 feet to 20 feet in width and stand without timbering. There being no falls of roof, air-courses are kept clean, giving a good passage-way for air. Rooms are driven 25 feet wide, with pillars 7 feet in thickness, and no attempt is made to remove the coal from room pillars. The ventilation is secured by a fan located at the old slope, 475 feet from the new one. This fan is 10 feet in diameter, driven by an engine whose cylinder is 7 inches by 12 inches, which produces a good current of air, which is carried fairly well to the working places.

LITTLE'S MINE.

Owned by the same company, located at Little's Station, on the E. & I. Railroad; was opened 1887. Its present capacity is 600 tons per day. It is opened by a shaft 80 feet deep. The mine is comparatively dry and has a hard bottom, the only drawback to the haulage being the uneven bottom, and the grades are light compared with other mines in the State. The coal is a fair quality of bituminous, $6\frac{1}{2}$ feet thick, with an excellent roof and slate bottom. Entries are driven from 8 to 12 feet wide, and the height of the coal. No timbering is required. Air-courses are in good condition and kept clean. Rooms are from 24 to 30 feet wide, well timbered, and pillars 12 feet thick are left to support the roof. A splendid man-way communicates with the escape shaft, which is available at all times to the employes. A fan 10 feet in diameter, located at the escape-way, furnishes an excellent current of air, which is well conducted around the faces of the entries and rooms. About 100 men are employed, under the management of Andrew Dodds, mine foreman.

CARBON MINE.

Located one mile west of Ayrshire. It is operated by William A. Jackson, of Oakland City, Ind., and was opened in 1894. It is developed through a slope 160 feet in length. The coal is 4 feet and 4 inches in thickness, and of an excellent quality of bituminous. The roof is a black slate and requires no timber to keep it safe in entries. This is well attended to. Air-courses are kept clean and the ventilation, produced by a furnace, is fairly good.

SULLIVAN COUNTY.

STAR MINE.

It is located at Gramercy Park, on a branch of the E. & T. H. Railroad; owned and operated by Harder & Hafer Coal Company, and is worked by a shaft 120 feet deep, with a vein of bituminous coal 5 feet in thickness. This is one of the best-equipped mines in the State, having the Prox. & Brinkman self-dumping cages; also the latest improved roller screens for screening the small coal. It is an electric machine mine, the Morgan-Gardner machine (six in number) being used. On my last inspection they were running the machines night and day. Eighty-five miners were employed, with a capacity of 700 tons daily. The mine is also well regulated in way of ventilating apparatus, an overcast being provided for every pair of cross-entries, thereby doing away with doors on the entries and making a saving of no small consequence in way of expenses; and also providing a fresh current of air for each pair of entries. I have made two inspections during the year, and at both visits I found the mine in good condition.

JUMBO MINE.

It is located at Jackson Hill, on the E. & T. H. Branch Railroad, which leaves the main line at Farmersburgh. This mine ceased operating on September 16th, 1897, by reason of a fire, which destroyed all the buildings and damaged the machinery to a great extent, entailing a great loss to the company. The company rebuilt and resumed operation on October 15th, the same year. The mine is worked by a shaft 24 feet deep, with a vein of bituminous coal 5 feet 8 inches thick and of good quality. It is a machine mine, in which the Harrison machine is used, 15 in number; employs 69 miners, and has a capacity of 500 tons daily. It is equipped with Prox. & Brinkman self-dumping cages, and is ventilated by two fans, one on each side of the shaft. At the last inspection it was found in a very satisfactory condition.

CURRYSVILLE MINE.

Located one mile north of Shelburn, on the E. & T. H. Railroad. It is owned and operated by the New Currysville Coal Company; worked by a shaft 260 feet deep, with two veins of bituminous coal, the upper being $3\frac{1}{2}$ feet and the lower $5\frac{1}{2}$ feet in thickness. This is the oldest mine on the E. & T. H. Railroad, having been opened in 1867, when the top vein was worked quite extensively. Some years later

the shaft was opened to the bottom vein, and the top abandoned; and it has been worked but very little since that time. Mr. Herbert Wooley, the superintendent, however, opened it in 1896, in order to get a few sample cars of the clay that underlies the coal, which he shipped to Evansville to have tested. I have not been able to learn the result of the test. The mine is worked partly by Harrison machines (three in number) and partly by hand. At my last inspection, made November 23d, it was in fair condition; 21 miners were employed, with a capacity of 120 tons daily.

PHENIX MINES No's 1 AND 2.

Located at Alum Cave, on the E. & T. H. Branch Railroad. This mine ranks among the largest machine mines in the State, the Harrison compressed-air machine being the kind used; but the company have lately begun the work of putting in an electric plant, and intend mining and hauling their coal at No. 1 shaft by electricity. This mine is also well equipped in hoisting and screening machinery, having the Prox. & Brinkman self-dumping cages and the latest improved roller small-coal screens, together with a large washer, making it the most complete small-coal arrangement in the State. The No. 2 mine is a slope mine, and is worked by hand. The coal is hauled from the bottom of the slope by rope to the surface, and then hauled by mules through the west side of the No. 1 to the bottom of the shaft, the coal from both mines being hoisted through the same opening and dumped together. The coal at both mines has an average thickness of 6 feet. I have made two inspections of each mine during the year, and at each visit found them in excellent condition; employing 76 miners at No. 1 and 22 at No. 2 mine, with a capacity of 800 tons daily.

HYMERA MINE.

Located at Hymera, on the Farmersburgh Branch of the E. & T. H. Railroad. It is owned and operated by Harder & Hafer, of Chicago, Illinois. It is a shaft opening 55 feet deep, with a vein of bituminous coal 5 feet 6 inches in thickness. This is one of the most costly-equipped mines in the State, having the Prox. & Brinkman self-dumping cages and the latest improved screening machinery, with electric mining and hauling machinery. The Morgan-Gardner machines (7 in number) are in use mining the coal, and two large motors for hauling the same.

There are employed 51 miners, with a daily capacity of 225 tons. At the last inspection the ventilation of the mine was in a very bad condition, so much so that several changes were ordered to improve the same. It should be said, however, in extenuation of this seeming mismanagement, that the mine had been idle for some time previous, and had recently changed ownership.

SHELburn MINE.

Located at Shelburn, on the E. & T. H. Railroad, and is worked by a shaft 240 feet deep, with a vein of bituminous coal $5\frac{1}{2}$ feet thick. It is a machine mine, in which both the Lehner and Harrison machines are used. There are 28 miners employed, with a capacity of 200 tons daily. During the year the ventilating fan was moved from the No. 2 to the No. 1 Mine, and hoisting of coal from the latter has been suspended since that time. The two shafts are connected underground. This should give good ventilation, if air-ways were placed in proper order. At the last inspection the ventilation was poor, and necessary changes were ordered to remedy the same. This is one of the few mines in Indiana that generates fire-damp in quantities which make close attention to the ventilation apparatus necessary. By enactment of the last Legislature it became imperative on the part of coal companies to file maps of their mines with the Inspector of Mines. The Shelburn Mining Company failed to do this in the required time, and the Inspector employed a surveyor to do the work. A copy of the map is now filed in the Inspector's office.

BUSH CREEK MINE.

Located three miles east of Sullivan, on the I. & I. S. Railroad, and is owned by Thomas Watson, of Chicago, Illinois. At the time of my last inspection this mine was idle, and remained so until October, 1897, when operations were resumed again and continued until November 25th. It again lapsed into idleness, and remains so at this time. I have made one inspection, on November 19th, when I found the mine in a very unsatisfactory condition, chiefly owing to a long period of idleness. Orders were given to make the necessary changes, which the company readily agreed to do.

FREEMAN MINE, OR BRIAR HILL

This mine is located one-half mile southeast of the town of Dugger, on the I. & I. S. Railroad. At the time of my last report the mine was being operated on a very small scale, there being only 8 men employed, those being the lessees of the mine at that time. Since that time the

mine has changed hands, and is now leased and operated by the Lyon-ton Coal Mining Company. There are now employed 35 miners, with a capacity of 125 tons daily. I have made one inspection during the year, and found the mine in good condition, and a full compliance with the law. This mine is equipped with the Prox. & Brinkman self-dumping cages, a roller screen for small coal, and a storage capacity of three 60-ton small-coal bins.

BUNKER HILL MINE.

Located four miles east of Sullivan, on the I. & I. S. Railroad. During the past year I have made two inspections of this mine, and found it in an excellent condition. It is worked by a shaft 72 feet deep, and has a vein of bituminous coal $4\frac{1}{2}$ feet in thickness, of good quality. While the mine is not equipped with modern machinery, yet it is one of the best laid-out mines in the State. Its capacity at last inspection was 100 tons daily, with 35 miners employed. This, however, is by no means the full capacity of the mine, which at that time was limited by scarcity of miners.

VANDELBURGH COUNTY.

DIAMOND MINE.

Near the north city limits of the city of Evansville, on the Stringtown road. It is operated by the Diamond Coal Company, and does an exclusively local trade. This, as are all mines in this county, is opened by a shaft to a vein of bituminous coal, that runs about 4 feet in thickness. It is a fair quality of steam and domestic coal. Owing to the competition from outside coals, none of these mines are very largely developed. About 90 tons per day are being produced at this mine. The company have been trying all summer to arrange their escape-way so that men can be taken out of it, but claim that they have been delayed by the failure of machine shops to furnish the necessary machinery on time. All of it was on the ground but a drum when I made my last inspection, and the manager promised that it would be in operation before the end of the year; but it has not been so reported.

UNION MINE.

One-half mile southeast of the above. It is operated by the Evansville Union Coal and Mining Company; was opened in 1891, and has been working some ever since. It is at present producing from 40 to 60 tons per day. An escape shaft was completed to this in 1896, and

the machinery with which it was sunk is still in the place, giving an available means of egress. The roof is a black slate, which cuts very badly after the coal is removed. The bottom is soft, and, water being allowed to lie on it, it becomes very muddy, and the hauling roads are in bad condition.

FIRST AVENUE MINE.

The improvements of this mine, noted in my report of last year, have been continued, and the mine is now in a fair condition. There is an indictment against the manager of this mine for violation of the law requiring an available means of escape besides the main hoisting shaft. No other complaint came to me of the condition of the mine.

SUNNYSIDE MINE.

This is the only mine in Vanderburgh County where mining machines are in use. Those of both the Harrison and Sergeant type are used. The production has been steadily increasing during the past 18 months, till now it has a capacity of 425 cars, which will average about one ton each. The shaft is 265 feet deep and is in good condition, but the tower and dump-buildings need repairing to conveniently handle the increase in output. The coal is all handled by mules, though the distance from the inside to the shaft bottom is 2,700 feet. For that distance the air has to be carried through old works. The ventilation is excellent, though the total volume is not so large as I have seen in other mines employing the same number of men.

UNITY MINE.

Was worked but a very little during the year. During the summer it was sold to a stock company, who intended to develop the north side of the mine, but dissension among the stockholders has delayed the work so that but seven men were employed when I visited the mine, December 18; and I made no inspection.

INGLESIDE MINE.

Located near the Ohio River, just below the city limits of Evansville. It is owned and operated by the John Ingle Coal Company. This is the oldest mine in the State, being opened in 1858, and has excavated a large area. Besides the local trade, the mine is convenient to the river and to the L. & N. Railroad, on both of which shipments are

made. Coal is brought to the bottom of the shaft by a tail-rope haulage system, 3,000 feet in length. The other conditions are much the same as other mines in the county, except that very little trouble is experienced from water. I have always found this mine in good condition and complying with the mining law, except in respect to an escape-way. A second outlet is provided by a shaft a quarter of a mile from the main shaft, but no means are provided by which men may enter or leave the mine at the second shaft. As long as the law required a stairway in the escape-way, I took no steps to enforce it, as, by obstructing the air, it would have done more harm than the circumstances warranted for the possible good. The law now giving, as an alternative, a hoisting apparatus, and the company having begun to arrange for this before, but failed to complete it, I have caused an indictment to be found against them in the Circuit Court, which is now pending.

VERMILLION COUNTY.

FERN HILL MINE.

Owned by the Hazel Creek Coal Company, of Clinton, Ind. It is located on a branch of the C. & E. I. Railroad, about one mile west of the town of Clinton. This mine has been in operation a number of years, and the underground works are quite extensive. Its capacity is about 600 tons per day, equally divided between lump and screenings. The coal is hoisted through a shaft 48 feet deep, and the second outlet is by a slope separated from the main entrance about 100 feet. Men and mules use this way exclusively for entering and leaving the mine. The main entry is driven double width, and has double track for 1,400 feet. There are very few heavy grades, and coal is brought from the workings to the bottom of the shaft without change in the make-up of the "trips," or of the mules pulling them. The roadbed is hard and dry, which makes the work a great deal easier on animals than when water and mud is on the road. The coal mined here is a good quality of bituminous, 5 feet in thickness, with a hard slate for a roof. Large bowlders, known as "nigger-heads" among the miners, are frequently found. These often fall, leaving "pot-holes" in the roof, and are very difficult to handle, as the material of which they are composed is so hard that it is almost impossible to break them. Some instances have occurred where they lay so far down into the coal as to cause entries to be turned to pass around them. Bottom is taken up to give entries a height of 5 feet 3 inches. They are driven in pairs 7 feet

wide, with pillars 18 feet thick between them. Rooms 21 feet wide, pillars 9 feet thick. Room pillars are not saved. The east side of the mine is worked out and abandoned, and a great deal of black damp is given off from these abandoned places into the air circulating through the mine, which makes it very difficult to secure good ventilation. In addition to this, I have nearly always found a very poor quality of oil burned in the mine, especially by drivers. At the time of my last visit 18 mules were being used. All of these came to the bottom of the shaft with their loads. On the main entry the air was so strong that ordinary oil would not hold a light; so drivers burned a mixture of coal oil. When they went to the working places they left a trail of smoke behind them which would hang until their next visit. Many miners say that as they have to suffer from the smoke, it is of no use to burn pure oil themselves, and buy the cheapest they can get and add to the difficulty. The result is that in spite of a good current of air, few places in the mine are in a condition fit to work in. The same facts are found at other mines in the State, but at none to so great an extent as here. The mine is ventilated by a 12-foot fan, and sends a sufficient quantity of air into the mine to supply a great many more men than I ever found employed there, but from the causes noted the ventilation is usually very poor.

BROUILLET'S CREEK MINE.

Owned by the Brouillet's Creek Coal Company. It is located one-half mile south of the above. This mine has heretofore been reported as the Indiana Bituminous Coal Company's No. 1 Mine. The present company was organized during this year. During the year 1896 the mine was remodeled, and it is one of the best-equipped mines in the State. Self-dumping cages are used, and about the only set of track scales at a coal mine in the State that are of sufficient strength and length to handle the largest coal cars without especial effort. A revolving screen is used to make nut coal, the screenings being elevated for that purpose. A 10x12 engine furnishes the power for this work. The total production at the time of my last visit was 700 tons per day, with a fair prospect of an increase in the near future. The shaft is 60 feet deep to the same vein of coal as is worked at the Fern Hill Mine, and what is said in regard to coal, roof and bottom there, applies equally to this mine. Coal is taken from but one side of the shaft, and, to facilitate handling it, a track has been made around the shaft at the bottom, the empty cars being taken from the cage on the east side, and pushed around to the west side to be taken into the

works. The main entry has a double track, and the mine is developed on the double-entry system. Ventilation is by a fan at the hoisting shaft, which supplies a good current of air to all parts of the mine. The only defect found on the last inspection was at a point where the works had broken into those of the Fern Hill Mine, where a great deal of black damp was found.

TORREY NO. 4 MINE.

Owned by the Torrey Coal and Mining Company. It is located near the town of Voorhees, $3\frac{1}{2}$ miles northwest of Clinton. The equipment of this mine is in good order, as all the buildings about the shaft were burned on June 12th, and the machinery was badly damaged and had to be completely overhauled. The boiler and engine room has been replaced by a brick building, and the shaft tower is enclosed with galvanized iron siding. The screens are stationary, but constructed entirely of iron, and seem to be very conveniently arranged. The production is 400 tons per day. The shaft is 75 feet deep to the vein that is now being worked, but has been sunk 175 feet farther to the "L" seam, and it is intended to develop this during 1898. The present workings are very wet, and the haulage roads are soft and difficult to keep in repair. The roof is generally very good, but there are some bad places, and falls frequently block air-courses and interfere with the ventilation. A tail-rope haulage system was used previous to the fire, but has not been placed in order since, all the coal now being brought to the bottom of the shaft by mules. Entries and air-courses are 8 feet wide and 5 feet high, this being the thickness of the coal. A fan at the hoisting shaft furnishes ventilation. A good volume of air is sent down the shaft, but stoppings and doors are so poorly constructed that most of the working places are smoky and foggy-looking. This is especially true where mining machines are at work and compressed air is being discharged. There are 11 Harrison and two Ingersoll-Sergeant mining machines in use.

BUCKEYE MINE.

Owned by McClellan, Eastman & Co. It is located one mile north of Fern Hill. It is in the territory where the upper vein was worked out by the Thompson Hill Coal Company. The present company sunk a shaft to the lower or "L" seam in 1895, and have been working since that time. The production is about 300 tons per day. The coal is from 5 feet 10 inches to 6 feet 6 inches in thickness, with a hard

clay bottom. The roof appears hard when the coal is removed, but after standing some time it cuts and falls in slabs. This has not occurred to any great extent in this mine yet, but it has begun, and, taking warning from what has happened elsewhere, the experiment is being tried of leaving a layer of coal under the slate. This is easily done, as there is a parting at which the lower coal separates about a foot from the top. There is also a clay band from 2 to 6 inches thick, $2\frac{1}{2}$ feet from the bottom. The plan of work differs very little from that described in the Parke County mines at Rosedale and Lyford. I have generally found the ventilation good in all working places here. The fan is driven by an engine 10 inches by 14 inches in size, geared by a link-belt to make two revolutions of the fan to one stroke of the engine. The air is divided into separate currents near the bottom of the shaft, thus giving a current of fresh air to each section of the mine.

VIGO COUNTY.

DIAMOND NO. 2 MINE.

Owned by the Coal Bluff Mining Company. It is located two and one-half miles southwest of Fontanet, on the Big Four Railroad. It was opened in 1895, but has not been worked very steadily. This mine is equipped with self-dumping cages, and an air compressor is in place, but no use has been made of it yet. Five hundred tons per day are being produced, all mined by hand. The shaft is 65 feet deep to the "L" vein, which shows all the characteristics noted elsewhere in describing this seam. Twenty-four-foot entry pillars and 15-foot room pillars are the rule, and nearly all of them are finally gotten out. The mine is well timbered and the safety of employes is well looked after. Ventilation is produced by a fan placed at the escape-way, 145 feet from the hoisting shaft, which produces an excellent current of air. All the working places are well ventilated. Bins have been erected with a view to putting in screening machinery.

PEERLESS MINE.

Owned by the Coal Bluff Mining Company. It is located one-half mile north of the crossing of the Big Four and C. & I. C. railroads. Shipments are made by the latter road. Shaking screens are used, the power being furnished by an 8x10 engine. The production is 200 tons per day, all mined by hand, but a great deal more could be handled. The shaft is 101 feet deep. The bottom is soft, but is well

drained, and haulage roads are good. Iron weighing 16 pounds per yard is used on main entries, and 12 pounds on cross-entries. The coal is good quality, 7 feet thick. It is soft, however, and does not bear handling. Entries and air-courses are 8 feet wide, with 40-foot pillars. Rooms are 24 feet wide, with 14-foot pillars, most of which are removed in finishing the mine. Ventilation and timbering are well attended to. The fan is situated at the escape-way, 100 feet from the hoisting shaft. The shaking screens were recently introduced. A bar screen is used to clean the lump coal and perforated plates to screen nut. A double eccentric is used which relieves the jar on the tippie. Its success was not assured at my last visit, as it had not been sufficiently tested at that time, but I have no doubt that it has come to stay.

UNION MINE.

Owned by the same company. It is located one and one-half miles northeast of Fontanet. Seven Harrison mining machines, driven by a Norwalk air-compressor, are in use at this mine. The mine is equipped with self-dumping cages and is producing about 700 tons of coal per day. The grates used under the boilers admit of burning the finest screenings that are made at the mine, and give good service. The shaft is 111 feet deep to the same vein that is worked at the Peerless. Haulage roads are good and the output is handled by 11 mules. Entries are 7 feet wide, with 24-foot pillars, rooms 22 feet, pillars 5 feet. The coal is nearly all saved. Near the bottom of the shaft some bad roof was found, but this is not the case in the present working part of the mine. Ventilation is produced by a 12-foot fan situated at the escape-way, 200 feet from the shaft. A good current of air was found in all entries on last inspection. Cross-bars of railroad iron are being used quite extensively on the north side of the mine, and have proven a success, especially in narrow entries. Rooms are well timbered.

BROADHURST MINE.

Owned by J. N. & G. Broadhurst. It is located one mile southwest of Macksville. It has been operated on a small scale for several years, the product being hauled in wagons to Terre Haute. There is no likelihood that more than a local business will be done, though from 20 to 30 men have been employed this year for this trade. The shaft is 89 feet deep, 6 feet by 12 feet in size. The coal is 5 feet in thickness, with a fair roof but very soft bottom. This gives trouble both in

making haulage roads and in keeping up the roof. Pillars are left 12 feet thick and are not removed. The mine was originally worked on a very poor system, but this has been improved during the last year, and it is now being developed systematically.

SEELEYVILLE MINE.

Owned by Julius Ehrlich. It is located immediately south of the town of Seeleyville, on the T. H. & I. Railroad. It has been opened for a number of years, but for some time past has worked very little. It is fairly well equipped for handling coal, having self-dumping cages, and plenty of hoisting power in a double engine with cylinders 22x42 inches. Everything about the pit top is in good condition, but very little coal is being produced. Only one side of the shaft is used for hoisting coal, a water box being used in the other. Part of the mine is being finished by drawing pillars. On my last inspection I found several rooms very smoky for lack of break-throughs between them. In other places the ventilation was good.

NICKEL PLATE MINE.

Owned by the Ehrman Coal Company, of Terre Haute. It is located on the Brazil Branch of the C. & E. I. Railroad, three miles southeast of Grant Station. The coal lies nearly on a level with the valley up which the railroad switch runs. The mine is developed under the hills on each side of the valley, and is ventilated by two fans, one on each side. Men and mules enter and leave the mine by a slope running from the bottom of the shaft to the surface, and a second outlet is provided by the air-shaft on the west side of the mine. The coal is soft, but of a good quality for steam purposes, and is 7 feet thick. The roof is a gray shale and very soft in some places, but the mine is well timbered. There is very little deviation from the usual plan of working. Ventilation was found to be good in all parts of the mine.

HECTOR MINE.

Owned by the Loughner Coal Company. It is located one-fourth of a mile west of Seeleyville, on the T. H. & I. Railroad. It was opened in 1896, and an escape shaft has been made this year. The production is about 300 tons per day, but only one side of the mine is being worked at present. The roof is good and the bottom hard. The roadways are well drained. The coal is from 6 to 7 feet in thickness, and

of fair quality. No timbering is necessary in entries, which are driven 12 feet wide. Rooms are 24 feet wide, and all pillars 12 feet thick. The work is well laid out, and as the company has a large territory, this is likely to be an important mine in the near future. Ventilation in those parts of the mine where work is being done is excellent.

GRANT MINE.

Owned by the Grant Coal Company. It is located on the Brazil Branch of the C. & E. I. Railroad, one-half mile south of the crossing of the Big Four at Grant Station. It was opened in 1889, and has quite a large territory worked out. In addition to the usual hoisting equipment an Ingersoll air-compressor is in use at this mine. The shaft is 80 feet deep; 600 feet of tail-rope haulage is in use, and all coal is being mined beyond that distance from the shaft. The track is laid with 16-pound iron on a good roadbed. The coal is 6½ feet in thickness, of the same character and quality as that at Fontanet. Large pillars are left both in entries and room work, and they are only partially saved. There is not enough attention given to the timbering of entries and air-courses, so that the ventilation is very imperfect in many places in the mine. This is caused in a great degree by the air having to be carried so far along abandoned works before reaching the working places. The road to the escape shaft is not very well timbered, and it has been necessary, on every visit I have made to this mine, for me to call the attention of the Superintendent to this fact. This road is seldom used and is therefore neglected. It is available in case of an accident, but should be kept in better order.

BRICK WORKS MINE.

Owned by the Terre Haute Brick and Pipe Company. It is located at their brick works, one mile northwest of Macksville. The product is nearly all used by the company. The mine is splendidly equipped, and is worked on a regular plan. An escape shaft has been completed during the year. It is 600 feet from the main shaft, and, as the coal is but 35 feet from the surface, it makes a convenient means of getting in and out. The ventilation is all that could be desired, a 10-foot fan having been placed at the mine during the year.

VIGO MINE.

Operated by Ed. Davis. It lies one and one-fourth miles northeast of the Nickel Plate Mine, and was originally opened in 1893. This is a slope, and two engines are used. One hauls the coal from the opening to the incline, which is built to the tippie, and another draws it to the tippie. The capacity is only 75 tons per day. The mine was in fair condition when last visited.

RAY MINE.

Owned by the Vigo County Coal Company. It is located one-half mile east of Seeleyville, on the T. H. & I. Railroad, and was opened in 1893. This mine has a very complete equipment, everything being in first-class shape. A double hoisting engine, with self-dumping cages, is used to bring the coal up the shaft. Elevating machinery carries the screenings to a roller screen, by which the nut coal is separated from the slack. The production of the mine is 350 tons per day. The shaft is 110 feet deep, and the coal 7 feet thick. The plan of working includes double entries 7 feet wide, separated by 21-foot pillars, rooms 28 feet wide, room pillars 12 feet. No pillars are taken out. A good escape shaft is provided. The fan is placed at this opening.

ST. MARY'S MINE

Operated by J. F. Erwin. It is located near the Convent of St. Mary's of the Woods, and is owned by the Sisters of Providence. This mine was opened in 1894, and, though it has never come under the provisions of the mining law, I found, on inspection, that it complied in all respects with its requirements, except that no safety catches were on the cages. The owners informed me that they were ordered, and I presume they have been put on before this time. The shaft is 97½ feet deep, and is excellently timbered and equipped. The working under ground is following the usual plan used in working similar veins of coal, and though not extensive, may be made so. Timbering and ventilation are excellent.

LARIMER MINE.

Operated by William Lankford. It is located on the National road, two miles southwest of Macksville. It is a shaft 125 feet deep, sunk in 1888, and has been working more or less ever since. Though a good deal of territory has been worked over, the mine is in excellent

shape, except parts that have been abandoned. A second opening has been made 900 feet north from the hoisting shaft, and an entry 7 feet wide and $4\frac{1}{2}$ feet high is driven between them. The production is about 50 tons per day. Ventilation and timbering were all that could be desired when inspected, and I have good reports from there ever since.

KRACKENBERGER MINE.

Owned by P. Krackenberger. It is located on the Paris road, one mile west of Macksville. It was opened in 1896, and but little has been mined from it. Everything about the pit top bears evidence of pinching in expenses, which gives a bad impression. The boiler and machinery are old, and the shaft buildings are cheaply constructed. The shaft itself is $4\frac{1}{2}$ feet by 5 feet in size, and a part of this is cut off for an air-chamber, in which a steam jet was used to produce a current of air. The underground works are laid off in a good manner, and if the shaft were enlarged to admit of two cages being used a good output could be secured. Entries are 6 feet wide, driven in pairs, with 45-foot pillars and rooms in proportion, the idea being to save pillars before abandonment. Since my inspection, connection has been made with an abandoned shaft, and a furnace built; this should secure good ventilation. The last three mines described, as well as Broadhurst's and several small mines west of the Wabash River, depend entirely upon wagon trade, having no railroad connections. Risher's, Eagle and Gruenholtz mines, which were mentioned in my last report, have not employed ten men at any time during the year, and I have not inspected No. 10 Mine since the water was gotten out of it at the close of the year.

WARRICK COUNTY.

STAR MINE.

Owned by John Archbold, Evansville, Ind. It is located on the Evansville Suburban & Newburgh Railway, one mile from Newburgh, and has shipping facilities by this railroad and by the Ohio River. The mine is well fitted up to handle coal and produces 220 tons per day. The shaft is 100 feet deep, and the coal 5 feet thick, of a fair quality of steam coal. The mine is dry and fairly level, so that good haulage roads are easily maintained. Entries are 14 feet in width and air-courses 8 feet. They are driven parallel, with a pillar of 15 feet between them, and stand without timbering. Rooms are 24 feet

wide, with pillars 12 feet thick. Pillars are left in the mine permanently. Ventilation is furnished by a fan at the escape-way 100 feet northwest of the main shaft. A good current of air is maintained throughout the mine, and during my term as Inspector there has been no necessity for any recommendations to improve the condition of the mine, on any of the visits of myself or assistant, as it has always been found in compliance with the law and is one of the best cared-for mines in the State.

CHANDLER MINE.

Owned by Patrick Bartly, Evansville, Ind. It is located near the depot at Chandler, on the Air Line Railroad. Its production is 50 tons per day. The shaft is in good condition, 115 feet in depth. It was opened in 1892, and there has been a great deal of trouble from decaying timbers in the bottom this year. The coal is 5 feet thick, of a fair quality of soft coal. The mine is dry and the haulage roads and air-ways are in good condition. About half the coal is left in pillars, and is not taken out on abandoning the working places. A second outlet has been made 400 feet south of the shaft, but for the two years previous to July, 1897, no attention had been paid to it and the road had become closed. A new shaft is now being sunk and will soon be finished. There were only 11 men working in the mine when inspected, July 30th, and, though the air current was weak, there was sufficient for the men employed.

GOUGH MINE.

Owned by Robert Gough, and operated by Kelly & Nester. It is located one-half mile east of Boonville, on the Air Line Railroad. This mine was opened in 1879, but has been operated only in a small way. The second outlet is by a slope 150 feet from the shaft, reached by a good road under ground. The hoisting shaft is 42 feet deep and the coal varies from 4 to 7½ feet in thickness, and is of good quality; excellent roof, except near the outcrop. The plan of working is very irregular, pillars being thin, and no attempt is made to save them. Places are well timbered and ventilation is good. Production, 150 tons mine-run coal per day, when inspected.

BIG VEIN MINE.

Owned by the J. Wooley, Jr., Coal Company. It is located one mile east of Boonville, on the Air Line Railroad. It was opened in 1891. This mine is opened by a slope. In addition to the necessary hoisting machinery an air-compressor is used, which furnishes power to two

Jeffery air-drills and three mining machines. The daily capacity is about 300 tons. The coal is an excellent quality of bituminous, and is from 6 to 8 feet thick. Ventilation is provided for by a fan located 50 feet from the slope, the outlet being furnished by openings to the surface where falls occur. The coal lying near the surface, the roof is very soft, but no trouble is experienced from this source in narrow work, as it is easily held by timber. The ventilation is good in the working places.

CALEDONIA MINE.

Owned by the Caledonia Coal Company, of Boonville, Ind. It is located east of the Big Vein Mine. It was opened in 1894, but for the greater part of the time not men enough have been employed to make the mining laws applicable. However, when visited, July 29th, the mining law was being fairly well complied with. The production at that time was 85 tons per day; this, as well as other mines in this part of the State, having a better market than usual on account of the general strike.

BRITZIN'S MINE.

Owned by William Robertson; near Newburgh, Ind. This mine was not employing 10 men when visited, October 21st, but the owner expected to have more during the fall and winter. This mine has connection with the E. S. & N. Railroad, and will ship coal to Evansville, in addition to local trade. It is in the same vein of coal as the Star Mine, and underground conditions will be the same as there, most likely. No inspection was made, but a second outlet was ordered to be made as speedily as possible.

TABLE No. 1.

Showing Men Employed Inside and Outside of Mines, Animals Used About Mines, Mines Opened and Abandoned During the Year, and Mines in Operation at the Close of the Year.

COUNTIES.	MEN EMPLOYED.		ANIMALS.	MINES.		
	Inside	Outside.		New.	Abandoned.	Working
Clay.....	2,320	195	196	7	5	31
Daviess.....	330	46	40	7	2	9
Dubois.....	15	2	1	1		1
Fountain.....	112	10	13	1		2
Gibson.....	85	12	13		1	1
Greene.....	751	77	69			7
Knox.....	113	18	9			3
Martin.....	33	2	2			1
Owen.....	31	4	3			1
Parke.....	715	88	58		1	18
Perry.....	58	5	6			2
Pike.....	343	49	60	1		6
Sullivan.....	554	63	76			12
Vanderburgh.....	183	26	33			6
Vermillion.....	432	35	44	1		5
Vigo.....	632	86	71	1		5
Warrick.....	128	21	18	1		8
Total.....	6,835	739	702	16	13	124

The above table refers, of course, to mines employing more than ten men, and a number of those listed as new mines are such as have come into the list during the year, having previously been operated on a smaller scale. On the other hand, mines which employed more than 10 men at the date of my last report, and are now employing less than that number, are classed as abandoned mines; so that the number of new openings and the number of mines finally abandoned are less than shown in the table, and some classed as abandoned may again increase their employees so as to bring them within the list of mines in operation.

TABLE No. 2.

Showing Production of Coal, Men Employed Inside and Outside of Mines, and Animals Used in the Mines During the Years 1896 and 1897, by Months.

MONTHS.	COAL PRODUCTION.		MEN EMPLOYED.				ANIMALS USED.	
	1896.	1897.	Inside.		Outside.		1896.	1897.
			1896.	1897.	1896.	1897.		
January.....	445,077	469,626	7,257	6,564	796	708	580	539
February.....	372,628	408,137	6,969	6,090	719	707	569	532
March.....	433,751	388,640	6,445	5,729	688	542	557	606
April.....	417,155	380,321	5,886	5,576	669	637	498	531
May.....	152,329	241,114	3,835	4,065	404	501	338	361
June.....	196,235	264,907	4,130	4,349	330	520	333	419
July.....	181,839	102,553	3,957	1,746	405	276	318	287
August.....	253,965	61,131	4,453	681	461	112	287	92
September.....	301,650	229,488	4,757	4,349	505	448	388	357
October.....	382,272	484,080	5,111	5,905	571	662	459	584
November.....	390,602	544,946	6,143	6,448	614	741	531	590
December.....	424,763	562,542	6,413	6,835	699	739	542	702
Small mines, estimated	136,398	150,000						
Total.....	4,068,124	4,228,085						

The increased estimate for small mines is based on the fact that many of them had a largely increased output during the strike of the larger mines from July to September.

TABLE No. 3.

Table Showing the Annual Production of Coal for the State of Indiana, from 1879 to 1896 Inclusive, as Shown by Reports of Mine Inspectors.

YEAR.	TONS.	CAPITAL.	INSPECTORS.
Oct., 1879, to Oct., 1880.	1,996,490	\$1,135,562	Richards.
1881	1,771,536	1,442,210	Wilson.
1882	1,991,000		
1883	2,540,000	1,800,000	Wilson.
1884	Est. 2,260,000	1,750,000	Wilson.
1885	2,375,000	1,850,000	McQuade.
1886	3,000,000	1,975,000	McQuade.
1887	3,140,979		McQuade.
1888			
1889	3,676,000	2,061,000	McQuade.
1890	3,714,479		Tislow.
1891	3,819,600	(new) 185,000	McQuade.
1892	4,494,811		McQuade.
1893	4,358,897		McQuade.
1894	3,440,363		McQuade.
1895	4,312,084	1,852,500	Fisher.
1896	4,068,124	1,750,000	Fisher.
1897	4,228,085	1,800,000	Fisher.

LABOR TROUBLES.

The year has been prolific of labor difficulties in the mines of this State, but, to the credit of the miners, generally, and especially of their leaders, but little violence occurred. As a result, the sympathy of the public has been with the miners, and an unbiased investigation and discussion of the condition of the coal business in all its phases has been possible for the first time in many years. The result has been to show that the wages paid in the mines of the State and its competing fields, taken in connection with the small amount of work that could be given, had brought the employes to a state of nearly absolute destitution. On the other hand, the selling price of coal had reached a point where operators could not afford to pay living wages, and make a profit on their product. The result has been that the price of coal to consumers has been advanced to some extent, and the present tendency seems to be upward, so that there are lively hopes that an era of comparative prosperity will soon be enjoyed in this industry.

The year began with a slight reduction in the output of this State, which fell from 424,763 tons in December, 1896, to 403,074 tons in January, 1897, but during the first four months of the year the monthly increase averaged 3,293 tons. Owing to the question of wages being amicably settled on May 1st, 1897, the next two months showed a large increase of production over the corresponding period of 1896, though it still did not reach one-half the production, monthly, of December, 1896, nor one-third the productive capacity of the mines of the State. The general strike which occurred on July 4th, referred to below, caused an almost complete paralysis of the coal business in this State. The coal produced during July and August, and the greater part of that produced in September, came from the southern end of the State, where a number of mines continued in operation; most of them, however, of small capacity. Some coal was also mined in Knox and Vigo counties. The agreement made in April, 1897, provided for a price of 51 cents per ton for pick mining in Standard Bituminous coal, and 61 cents per ton in Standard Block coal, with extras for deficient coal, yardage and room timbering, based on this price. Machine mining was also governed by the price paid for pick mining, as had been customary in this State. On July 3d, a majority of the miners of the State ceased work, in common with those of Illinois, Ohio, western Pennsylvania and parts of other States, in response to an order from the national organization of United Mine Workers, and within a few days thereafter the strike extended to all

mines from Washington northward, with a few unimportant exceptions, and they were employed principally in supplying local trade. The strike, which at one time affected 125,000 miners in the Central Western States, continued until September 12th, when an agreement was reached by which nearly all began work within 10 days thereafter. In some parts of the territory, however, notably northern Illinois, the struggle was continued into December, on account of a failure to adjust the general settlement to local conditions. This affected the business in Indiana by curtailing the supply of coal in the market and making a greater demand here. This, together with the fact that stocks had been depleted by the long idleness, had the effect of stimulating production here, which would have been greater than is shown but for the scarcity of men and of railroad cars. On the basis of the September agreement, pick mining in Indiana was advanced 5 cents per ton, with a proportionate increase in other classes of work. The only difficulty that was left unadjusted in this State was that at Washington, referred to above. The company imported miners from the Kentucky coal fields, and put them to work in their mines, which are now running with a much smaller force than usual. Many of the old men have secured work in other places, but probably one-third of those who came out on strike are still continuing the struggle. While the advantage in a financial way from the strike was slight, comparatively, it gave the miners opportunity to let the public know their actual condition, and secure sympathy and, to a certain extent, co-operation, in their efforts to better it, also brought about a bitter feeling among all interested in the industry than has prevailed for years. The miners' organization has been greatly strengthened, and greater confidence is reposed in their leaders by the workmen, than has been the case for some time past. The effect of all this is bound to be that employers will enter agreements with the miners' officials with confidence that they will be carried out in good faith, and great benefits will be derived in the future, as much of the uncertainty attending the operation of mines will be removed, and sales of coal can be made with the assurance that strikes will not interrupt its delivery. It is to be hoped that the present good feeling will continue. The present mining rate is to continue until January 15th, 1898, and a conference of miners and operators is to be held at Chicago on January 17th, to fix the price for the year 1898.

TABLE No. 4.

Giving a List of Mines Employing More than Ten Men, the Names and Addresses of Mine Bosses and the Number of Men and Mules Employed at Each, January 1, 1898.

CLAY COUNTY.

MINE BOSS.	ADDRESS.	MINE.	EMPLOYEES.		
			Inside.	Outside.	Mules.
John Bolin	Brazil	Brazil Block No. 1	112	19	10
Wm. Conroy	Brazil	Gart No. 3	125	10	15
Andrew Gilmour	Cardonia	Gart No. 5	204	10	12
James Baxter	Brazil	Brazil Block No. 7	19	2	1
August Norkus	Diamond	Brazil Block No. 8	188	22	19
		Brazil Block No. 10	7	1	1
Martin Navin	Diamond	Brazil Block No. 11	110	8	5
Robert J. Wallace	Diamond	Brazil Block No. 12	37	9	1
W. P. McQuade	Brazil	Gladstone	138	9	12
A. L. Boore	Clay City	Briar Hill	34	6	3
Charles Nash	Clay City	Harrison No. 2	77	6	6
		Harrison No. 3*			
H. W. Jenkins	Perth	Pratt	60	8	6
Walter Knox	Asherville	Crawford No. 2	78	6	6
Wm. Penze	Brazil	Crawford No. 3	107	7	6
Samuel Lindsay	Brazil	Crawford No. 4*			
R. F. Jenkins	Knightsville	World's Fair	59	3	3
James Cuthbertson	Cardonia	Diamond No. 3	159	7	8
		Klondyke*			
H. B. Ehrlich	Brazil	Excelsior	27	4	4
T. J. Russell	Turner	Superior	55	5	3
W. T. Hopkins	Carbon	Eureka No. 2	179	8	16
John Quigley	Carbon	Eureka No. 3	23	2	6
James A. King	Brazil	Monarch	15	1	2
Moses Marks	Cardonia	Brazil	139	8	9
John Cox, Sr.	Brazil	Nickel Plate	36	3	4
Peter Andrew	Clay City	Markland	34	3	5
W. J. Price	Cardonia	Fairview	56	5	5
Ed. Somers	Staunton	San Pedro	42	7	4
Griff Howell	Center Point	Louise	75	6	6
M. Hofmann	Asherville	Columbia No. 3	14	2	1
Thos. Thompson	Hoosierville	Columbia No. 4	83	5	4
F. J. Urbain	Brazil	Victoria	28	3	3
Total			2,320	195	186

DAVISS COUNTY.

Anton Kocher	Washington	Cabel No. 4	31	3	3
Joseph W. Small	Washington	Cabel No. 9	54	8	8
James E. Brown	Washington	Montgomery No. 1	66	10	14
Geo. E. Brown	Washington	Montgomery No. 2	40	4	5
Geo. E. Brown	Montgomery	Montgomery No. 3*			
Daniel W. Davis	Cannelburg	Mutual	47	9	4
A. W. Stuckey	Raglesville	Stoy	16	2	
W. A. Jacobs	Raglesville	Union	16	2	1
		Co-operative*			
Thomas Harris	Washington	Hawkins	37	6	3
J. Teverbaugh	Washington	Wilson's No. 4	23	2	2
Total			330	46	40

* New mines; no reports yet.

TABLE No. 4-Continued.

DUBOIS COUNTY.

MINE BOSS.	ADDRESS.	MINE.	EMPLOYEES.		
			Inside.	Outside.	Mules.
W. A. Barrowman.....	Huntingburgh.....	Huntingburgh.....	15	2	1
Total.....			15	2	1

FOUNTAIN COUNTY.

Steward Shirkie.....	Silverwood.....	Ind. Bituminous Co.	92	7	12
J. S. Tilley.....	Silverwood.....	Silverwood.....	20	3	1
Total.....			112	10	13

GIBSON COUNTY.

Thomas J. Thomas.....	Princeton.....	Oswald.....	85	12	13
Total.....			85	12	13

GREENE COUNTY.

S. C. Risher.....	Linton.....	Island City.....	98	12	7
J. S. Newport.....	Linton.....	Island No. 2.....	165	21	17
Wm. Walton.....	Linton.....	Island Valley.....	67	5	5
James Dunn.....	Linton.....	Fluhart.....	122	11	12
Joseph Ferry.....	Linton.....	South Linton.....	69	6	5
W. H. Sexton.....	Dugger.....	Summit.....	119	12	17
John Templeton.....	Linton.....	Templeton.....	111	10	6
Total.....			751	77	69

KNOX COUNTY.

R. M. Freeman.....	Bicknell.....	Bicknell.....	41	4	2
M. Atkison.....	Edwardsport.....	Hofmann.....	50	8	4
W. R. Scott.....	Vincennes.....	Prospect Hill.....	22	6	3
Total.....			113	18	9

MARTIN COUNTY.

M. Dickie.....	Short's.....	Bedford.....	33	2	2
Total.....			33	2	2

TABLE No. 4—Continued.

OWEN COUNTY.

MINE BOSS.	ADDRESS.	MINE.	EMPLOYES.		Mules.
			Inside.	Outside.	
James T. Andrews	Clay City	Lancaster No. 4	31	4	3
Total .....	.....	.....	31	4	3

PARKE COUNTY.

George E. Davis	Coxville	Cox No. 3	134	22	8
John A. Bolin	Carbon	Otter Creek	48	4	4
John Mushet	Lyford	Lyford No. 1†	40	6	5
H. Schlatter	Carbon	Lyford No. 2	95	6	7
W. L. Wallace	Perth	Crawford No. 1	90	6	6
James Skene	Mecca	McIntosh No. 1	40	6	5
Morgan Roberts	Mecca	Mecca No. 1	65	11	6
George Mitch	Rosedale	Mecca No. 2†	80	6	3
John J. Scott	Brasil	Parke No. 8	75	9	8
George Myers	Brasil	Standard	48	12	6
John Chesterfield	Brasil	Columbia No. 1 .....	.....	.....	.....
.....	.....	Columbia No. 2 .....	.....	.....	.....
Total .....	.....	.....	715	88	58

PERRY COUNTY.

Geo. W. Briggs	Cannelton	Cannelton	42	4	4
R. C. Walker	Troy	Troy	16	1	2
Total .....	.....	.....	58	5	6

PIKE COUNTY.

G. Wellinger	Augusta	Hartwell	45	7	14
John Jennings	Ayrshire	Ayrshire	160	15	21
John R. Willey	Petersburgh	Blackburn	49	9	6
Andrew Dodds	Littles	Little	123	8	11
Bart Stinson	Sophia	Carbon	20	6	2
H. T. Brewis	Petersburgh	Wooley	46	5	6
Total .....	.....	.....	343	49	60

SULLIVAN COUNTY.

J. A. Beck	Dugger	Briar Hill	35	4	2
Frank Smith	Farnsworth	Bunker Hill	49	6	5
S. Campbell	Del Carbo	Star	77	14	16
H. A. Butler	Dugger	Dugger	69	8	7
W. E. Evans	Eagle	Jumbo	98	18	17
R. M. Irving	Shelburn	Currys ville	32	10	3
Wm. F. Brown	Alum Cave	Phenix No. 1	123	20	15
Wm. Britton	Alum Cave	Phenix No. 2	21	1	3
.....	Hymers	Hymers* .....	.....	.....	.....
D. M. Hopkins	Shelburn	Shelburn Nos. 1 and 2	50	12	8
A. Winterbottom	Farnsworth	Bush Creek† .....	.....	.....	.....
Total .....	.....	.....	554	63	76

* No report. † Shut down.

TABLE No. 4--Continued.

VANDERBURGH COUNTY.

MINE BOSS.	ADDRESS.	MINE.	EMPLOYEES.		
			Inside.	Outside.	Mules.
Geo. Bonenberger	Evansville	Diamond	26	4	6
Pius Schultheis	Evansville	Union	25	5	4
John Odell	Evansville	Ingleside	22	10	3
Frank Gendthar	Evansville	First Avenue	36	8	8
C. H. Baetz	Evansville	Sunnyside	74	9	12
Total			183	26	33

VERMILLION COUNTY.

Frank Dunlap	Clinton	Fern Hill	92	8	18
D. W. James	Clinton	Brouillet's	133	8	6
Wm. Hutchinson	Voorhees	Torrey No. 4	131	11	14
Wm. Chesterfield	Clinton	Buckeye	76	8	6
		New Hazel*			
Total			432	35	44

VIGO COUNTY.

Thomas Gregory	Fontanet	Diamond No. 2	118	7	7
G. R. Anthony	Fontanet	Peerless	76	7	5
James Johnson	Fontanet	Union	150	13	11
J. W. Erwin	Macksville	Broadhurst	15	3	2
J. Carmichael	Seeleyville	Ehrlich	40	6	3
Wm. Grey	Seeleyville	Hector	62	6	4
Thomas McQuade	Burnett	Nickel Plate	60	8	13
James Devonald	Burnett	Grant	90	10	14
Wm. Gatt	Rosedale	Parke No. 10	71	9	4
Robert Bieler	Macksville	Brick Works	9	1	1
John W. Alvis	Elsie	Vigo	28	2	3
Geo. West	Seeleyville	Ray	68	9	3
W. L. Erwin	St. Marys	St. Mary's	22	3	1
James Steele	Macksville	Larimer	23	2	
Total			632	86	71

WARRICK COUNTY.

Geo. Archbold	Newburgh	Star	34	5	4
Patrick Bartley	Chandler	Chandler	13	2	2
Wm. Nester	Boonville	Gough	19	3	3
T. B. Hall	Chandler	Air Line	7	3	1
Wm. Wooley	Boonville	Big Vein	36	6	6
F. P. Hargrove	Boonville	Caledonia	19	2	2
Total			128	21	18

* No report.

TABLE No. 5.

Showing the Production of Coal in Tons of 2,000 Pounds in Indiana During the Year 1897.
CLAY COUNTY.

OWNER.	ADDRESS.	MINE.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Allais & Urban.	Brazil	Victoria	500	630	916	847	895			Strike		716	1,777	1,478	7,849
Brazil Block Coal Co.	Brazil	No. 1	7,182	4,974	6,565	5,594	3,887	2,767	383		2,530	6,683	5,467	8,982	56,648
Brazil Block Coal Co.	Brazil	Gart No. 3		2,081	2,197	2,844	3,957	1,979			2,547	1,183	6,537	4,363	27,897
Brazil Block Coal Co.	Brazil	Gart No. 5	7,853	6,121	4,638	6,983	1,245	2,166	343		5,427	12,485	11,566	10,130	66,642
Brazil Block Coal Co.	Brazil	No. 7										9,801	11,772	1,478	91,456
Brazil Block Coal Co.	Brazil	No. 8	13,546	11,772	13,334	12,447		3,526	781		3,946	9,801	11,783	11,783	1,478
Brazil Block Coal Co.	Brazil	No. 10	775	607	637	627						471	627	6,210	4,456
Brazil Block Coal Co.	Brazil	No. 11	6,204	3,664	134						3,214	8,296	8,067	6,210	36,233
Brazil Block Coal Co.	Brazil	No. 12											414	1,708	1,708
Brazil Mining Co.	Brazil	Gladstone	6,152	5,331	5,631	6,364	2,446	1,721	339		2,818	6,000	6,500	6,500	51,002
Briar Hill	Clay City	Briar Hill	900	1,200	770	700	1,480	1,200				1,070	1,800	840	3,160
Chicago and Indiana Coal Co.	Terre Haute	Harrison No. 2	3,446	4,455	5,753	701	944	703	80		937	3,280	3,298	4,400	22,896
Coal Bluff Mining Co.	Terre Haute	Pratt	5,482	5,124	5,700	3,741					3,112	4,621	4,546	3,571	35,087
Crawford Coal Co.	Brazil	Crawford No. 2	5,736	5,236	5,226	6,102	1,033	4,832	418		3,769	7,535	7,535	3,571	51,036
Crawford Coal Co.	Brazil	Crawford No. 3	5,742	5,302	3,071	3,526	838	2,612	49		4,068	8,061	6,542	5,449	46,060
Crawford Coal Co.	Brazil	Crawford No. 4													
D. H. Davis Coal Co.	Brazil	World's Fair	1,543	1,479	1,309	1,191	824	759			1,378	3,197	2,846	2,943	17,489
C. Ehrlich Coal Co.	Knightsville	Knightsville	2,418	2,425	784	3,678									9,006
C. Ehrlich Coal Co.	Turner	Excelsior													7,464
P. Ehrlich & Co.	Turner	Superior	5,638	2,513	3,576	4,330	2,964	1,891			1,188	2,623	3,215	1,362	13,873
Eureka Coal Co.	Turner	Eureka No. 2	11,152	10,515	3,566	9,677	2,946	3,444	536		7,509	5,443	10,721	7,578	41,733
Eureka Coal Co.	Terre Haute	Diamond No. 3													74,517
Diamond Block Coal Co.	Chicago, Ill.	Diamond No. 3	9,031	9,472	8,823	8,280	4,520	2,404	96	47	3,406	8,441	8,542	7,511	70,373
Goucher, McAdoo & Co.	Brazil	Monarch	750	4,153	600	653		622	578	559	572	608	636	645	6,221
Jackson Coal and Mining Co.	Brazil	Nickel Plate	5,021	4,038	4,038	4,038	1,980	282	282		5,074	10,216	9,653	4,975	50,389
Jackson Coal and Mining Co.	Brazil	Markland	2,562	2,078	1,840	2,567	939	20						1,604	13,301
L. McIntosh & Co.	Brazil	McIntosh No. 2	641	118	100	100	100	113	144	193	522	1,310	1,495	1,378	769
Andrew & Burnham	Clay City	Fairview	100	100	2,611	2,010	2,547	4,280			924	2,421	2,523	2,561	5,055
Otter Creek Coal Co.	Brazil	Nellie	929	1,072	713	785									28,163
Jos. Somers	Stanton	San Pedro	2,431	2,623	2,215										3,569
Weaver Coal Co.	Center Point	Louise	390	1,050	3,058	2,811					2,640	1,100	2,720	2,787	16,162
Zeller, McCellan & Co.	Brazil	Columbia No. 3	2,105	3,891	3,058	2,811					566	1,731	3,450	3,000	11,000
Zeller, McCellan & Co.	Brazil	Columbia No. 4	3,668	2,140	1,753	2,597	1,053	1,662	196		2,529	5,686	4,586	3,786	29,366
Total			116,003	104,425	85,898	95,355	32,998	39,163	4,407	799	60,986	124,517	134,290	126,538	925,679

*Idle. †New mine. ‡Abandoned. §Included in line above.

GIBSON COUNTY.

Maple Coal Co.....	Princeton.....	Oswald.....	7,500	4,900	3,750	1,250	1,500	2,007	4,000	2,171	3,000	5,800	7,300	6,780	49,878
Total.....			7,500	4,900	3,750	1,250	1,500	2,007	4,000	2,171	3,000	5,800	7,300	6,780	49,878

GREENE COUNTY.

Island Coal Co.....	Indianapolis.....	Island City.....	5,753	8,280	6,048	5,750	15,380	3,881	676	9,372	18,714	10,321	10,000	59,815
Island Coal Co.....	Indianapolis.....	Island No. 2.....	12,222	12,547	15,380	10,764	3,105	11,811	676	5,283	16,714	17,407	17,000	128,584
Island Valley C. & M. Co.....	Linton.....	Island Valley.....	4,253	5,830	4,250	3,400	1,850	2,509	988	1,413	5,283	6,304	6,175	44,573
Linton C. & M. Co.....	Linton.....	Fluhart.....	4,768	9,815	10,582	3,435	2,850	2,062	700	1,507	8,278	9,168	8,381	64,502
South Linton Coal Co.....	Linton.....	South Linton.....	4,715	4,715	4,725	3,950	2,850	4,725	902	1,075	8,286	7,250	9,000	44,745
Summit Coal Co.....	Bloomfield.....	Summit.....	5,435	6,455	6,455	4,472	6,854	5,400	902	3,783	11,915	13,215	14,165	79,451
Western Indiana Coal Co.....	Terre Haute.....	Templeton.....	3,589	4,280	1,530	3,953	7,160	5,528	417	1,692	7,451	10,425	8,758	55,251
Total.....			44,740	47,517	49,969	35,794	37,179	36,334	3,083	9,370	68,078	74,063	73,980	477,501

KNOX COUNTY.

Bicknell Co-operative C. Co.....	Bicknell.....	Bicknell.....	1,500	840	987	150	324	343	556	208	975	2,371	2,932	2,908	13,972
Edwardsport Coal Co.....	Indianapolis.....	Hofmann.....	2,463	2,742	2,535	870	935	1,101	359	738	2,624	2,500	2,500	2,500	19,167
Prospect Hill Coal Co.....	Vincennes.....	Prospect Hill.....	1,090	839	749	381	290	383	853	1,510	1,142	982	1,240	1,118	10,577
Total.....			5,053	4,421	3,851	1,401	1,549	1,827	1,768	1,718	2,855	5,877	6,572	6,524	43,718

MARTIN COUNTY.

Bedford Coal and Mining Co.....	Bedford.....	Bedford.....	612	990	722	498	685	700	700	700	700	750	900	1,100	9,087
Total.....			612	990	722	498	685	700	700	700	700	750	900	1,100	9,087

*Idle.

TABLE No. 5—Continued.

OWEN COUNTY.

OWNER.	ADDRESS.	MINE.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lancaster Block Coal Co.....	Terre Haute	Lancaster No. 4	2,331	1,534	1,315	2,230	831	455			700	2,000	2,100	1,403	15,419
Total.....			2,331	1,534	1,315	2,230	831	455			700	2,000	2,100	1,403	15,419

PARKE COUNTY.

Brazil Block Coal Co.....	Brazil	Cox No. 3.	8,228	10,943	11,359	6,846	9,557	10,344				6,890	13,576	15,853	93,871
Brazil Block Coal Co.....	Brazil	Otter Creek	211	1,060								2,109	2,511	2,503	8,540
Calumet Coal Co.....	Chicago, Ill.	Lyford No. 1	1,019		7,169	9,503	10,843	2,281				6,399	10,129	8,051	1,019
Crawford Coal Co.....	Brazil	Lyford No. 2	5,969	3,908	4,718	3,256	196		341			4,566	7,125	4,280	55,070
L. McIntosh & Co.....	Brazil	Crawford No. 1	7,227	5,800	6,869	7,452	3,641	4,629	144		3,572	3,540	3,514	4,244	33,709
Otter Creek Coal Co.....	Brazil	McIntosh No. 1	1,004	2,393	2,357	2,524	1,039	1,563	646		47	2,600	3,286	4,140	22,136
Otter Creek Coal Co.....	Brazil	Mecca No. 2	665	719	939	582									2,965
Parke County Coal Co.....	Rosedale	Mecca No. 3	5,862	6,114	5,620	8,078	5,284	9,154				682			41,633
Parke County Coal Co.....	Rosedale	Parke No. 6	4,354	6,113	3,576	6,773	8,097	8,390				8,236	11,067	12,015	71,638
Standard Coal Co.....	Terre Haute	Parke No. 8	2,838	2,532	4,648	3,308	722	1,527	123		3,067	4,620	3,224	5,069	31,740
Zeller, McClellan & Co.....	Brazil	Standard	4,185	4,090	1,912	3,173					2,103	6,940	8,090	7,578	33,071
Zeller, McClellan & Co.....	Brazil	Columbia No. 1	3,584	3,606	4,034	4,986	1,905	2,694	382		2,513	7,038	8,240	7,636	46,628
Total.....		Columbia No. 2	45,146	49,937	53,231	56,571	41,944	40,882	1,646		14,086	53,790	71,962	72,289	500,334

PERRY COUNTY.

American Cannel Coal Co.....	Cannelton	Cannelton	1,116	1,184	1,494	1,543	1,348	1,229	1,631	781	1,405	384	854	1,423	14,507
Bergenth Bros.....	Troy	Troy	1,000	760	1,140	807	746	886	764	758	844	760	611	1,104	10,180
Total.....			2,116	1,944	2,634	2,350	2,094	2,115	2,395	1,539	2,249	1,144	1,465	2,527	24,687

†† Shaft buildings burned.

PIKE COUNTY.

	Washington.	Hartwell.	2,940	2,880	2,205	2,765	350	12,458	1,077	2,069	1,716	1,962	2,767	17,976
Cabel-Kaufman Coal Co.	Oakland City	Ayrshire	6,942	6,561	4,675	3,297	3,719	1,754	13,020	14,541	13,567	12,386	10,531	106,573
D. Ingle	Oakland City	Carbon	1,777	1,223	1,065	1,962	1,285	1,754	780	1,614	1,360	1,729	1,496	17,051
W. A. Jackson	Evansville	Blackburn	2,194	1,387	5,777	4,405	2,954	3,455	1,954	4,153	4,981	11,000	3,541	3,541
The S. W. Little Coal Co.	Evansville	Little's	3,783	3,797	5,777	4,405	2,954	3,455	1,954	4,153	4,981	11,000	3,541	71,560
The J. Wooley, Jr., Coal Co.	Evansville	Petersburg				1,408	1,347						9,645	20,943
Total			17,836	15,848	13,712	11,285	10,972	17,667	16,781	34,453	32,713	27,083	29,839	287,454

SULLIVAN COUNTY.

	Dugger.	Briar Hill	150	150	125	150	100	100	100	100	700	1,000	800	3,975
Lyonton Coal Mining Co.	Farnsworth	Bunker Hill	2,289	1,966	1,383	617	491	651	162	803	2,141	2,544	3,083	16,148
Hancock & Conkel Co.	Del Carbo	Star	13,469	14,663	8,960	15,464	7,813	13,258	7,729	14,236	15,431	11,018	16,963	139,311
Harder Hafer Coal Co.	Dugger	Dugger	6,241	5,716	2,718	1,351	6,924	5,380	4,540	566	3,855	3,977	4,858	25,285
Indiana & Chicago Coal Co.	Eagle	Jumbo	11,047	11,898	9,261	11,431	6,924	5,380	4,540	566	3,855	3,977	4,858	25,285
Jackson Hill Coal Co.	Shelburn	Currysville	1,500	1,472	978	687	749	11,325	6,748	3,991	15,431	11,018	16,963	139,311
New Currysville Coal Co.	Alum Cave	Phenix Nos. 1 & 2	14,300	11,628	14,350	11,447	1,440	1,000	299	480	2,174	2,174	5,736	76,453
Hymera Coal Mining Co.	Hymera	Hymera	3,000	3,000	1,800	1,320	1,440	1,000	299	480	2,174	2,174	5,736	12,855
Shelburn Coal Mining Co.	Shelburn	Shelburn No. 1	2,120	2,000	1,440	1,500	1,500	1,800	299	2,025	2,640	2,700	2,900	117,548
Shelburn Mining Co.	Shelburn	Shelburn No. 2												22,124
Watson Little Coal Co.	Farnsworth	Bush Creek												20,824
Total			54,115	52,483	40,835	43,997	19,047	35,525	20,117	22,135	42,009	42,074	64,506	435,398

VANDERBURGH COUNTY.

	Evansville.	Diamond	2,992	2,816	2,784	1,440	1,320	1,158	1,463	1,072	1,678	1,640	1,885	22,791
Diamond Coal Mining Co.	Evansville	Union	1,462	1,041	763	512	457	443	637	600	949	1,122	1,510	10,997
Evansville Union C. & M. Co.	Evansville	Ingleside	6,966	5,973	7,641	4,539	4,084	4,368	5,811	7,000	6,300	6,250	6,500	71,574
John Ingle Coal Co.	Evansville	First Avenue	1,898	1,797	1,510	1,145	1,316	1,559	2,752	2,573	2,578	3,168	3,770	27,566
H. A. Lozier	Evansville	Sunnyside	5,945	5,164	5,408	3,304	3,603	2,973	6,927	6,552	7,726	7,798	8,272	72,228
Sunnyside Coal & Coke Co.														
Total			19,263	16,791	18,106	10,940	10,782	10,491	17,590	17,797	19,191	20,178	21,937	205,256

* Idle. † Abandoned. ** Shut down. ‡ Burned.

TABLE No. 5—Continued.

VERMILION COUNTY.

OWNER.	ADDRESS.	MINE.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Hazel Creek Coal Co.	Clinton.	Fern Hill.	6,560	10,425	12,434	12,450	3,389	2,055			8,166	10,759	12,845	11,000	90,083
Hazel Creek Coal Co.	Clinton.	Hazel No. 3.	†								5,627	13,202	16,529	11,500	46,858
Brullette's Creek Coal Co.	Clinton.	Brullette Creek					6,682	7,883			2,000	6,200	8,000	7,500	81,527
McClellan, Eastman & Co.	Clinton.	Buckeye	950	7,686	9,723	6,793	6,682	7,883			233	4,149	7,074	7,000	83,660
Torrey Coal Co.	Voorhees.	Torrey No. 4	9,840	10,325	12,649	13,352	13,043	5,956							
Total			17,250	28,486	34,806	32,595	23,114	15,943			16,026	34,310	44,448	37,000	283,928

VIGO COUNTY.

OWNER.	ADDRESS.	MINE.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
J. N. & Geo. Broadhurst	Mackeyville	Broadhurst.	1,247	1,000	1,000	1,000									
Burke Bros.	Glenn	Burke	100	100	100	100									
Coal Bluff Mining Co.	Terre Haute	Diamond No. 2.	2,915	803	3,995	4,494	3,971	4,033	499						
Coal Bluff Mining Co.	Terre Haute.	Peerless	2,230												
Coal Bluff Mining Co.	Terre Haute.	Star	1,448	740	1,088	1,040									
Coal Bluff Mining Co.	Terre Haute.	Victor	7,796	10,178	13,118	13,940	11,538	15,583	1,252						
Coal Bluff Mining Co.	Terre Haute.	Union													
Edward Davis	Elsie	Eagle.													
James H. Erwin	St. Mary's	St. Mary's	500	500	500	500	500	500	500						
Khrman Coal Co.	Burnett	Nickel Plate	3,820	5,886	3,716	5,065	4,670	4,863							
Julius Ehrlich	Seeleyville	Seeleyville	546	1,823	1,692	1,032	216	726	1,055						
Grant Coal Mining Co.	Burnett	Grant	11,106	10,183	10,704	11,400	9,638	9,083							
T. H. Brick and Pipe Co.	Terre Haute.	Brick Works.	700	685	720	715	700	765	755						
Soales Bros.	Terre Haute.	Soales	500	500	500	500	500	500	575						
Edward Davis	Vigo	Vigo	1,200	2,100											
William Lankford	Elsie	Seeleyville	575	684	628	331	241	213	742						
Loughner Coal Co.	Mackeyville	Larimer	2,001	2,498	2,902	3,879	1,190	4,538	458						
Vigo County Coal Co.	Seeleyville	Hector.	4,084	4,307	4,503	6,587	284	1,705							
Murry & Lloyd	Seeleyville	Ray.													
Parke County Coal Co.	Mackeyville	Murry.													
	Rosedale	Park No. 10													
Total			38,038	42,067	45,019	53,029	33,583	44,465	8,595	6,406	21,557	53,208	66,383	72,744	486,994

METHODS OF MINING.

There are seven different veins of coal mined in the State of Indiana, varying in thickness from three to nine feet. Room and pillar is the only system of mining used in this State, subject to many modifications as to the direction and width of entries, the thickness of entry pillars, the width of rooms, and the arrangements for the recovery of the coal in the room pillars before the final abandonment of the mine. These modifications are made necessary by the character of the coal and of the overlying and underlying strata. This system, when conditions are favorable, as they are in but few mines in this State, consists of a main entry and air-course, each 8 feet wide, separated by a pillar 12 feet in thickness, and making what is known as a double entry. At intervals of 100 yards cross-entries are driven at right angles to the main entries. These are of the same dimensions as the main entry, but the pillar between them is usually not so thick, and a haulage road is kept up in each cross-entry. Break-throughs are made between each pair of entries every 45 feet to provide for the circulation of the ventilating current through the mine. These entries are driven to the boundaries of the territory in each direction. As the cross-entries are being driven, rooms are "turned" at right angles. These are started at a width of 8 feet and are gradually widened to 24 feet. They are carried at this width until they reach a point midway between the two cross-entries. The roadway is kept near one side of the room, so that it is in place to be used in taking the coal from the pillars. These are left standing until the mine, or at least that part of it, is about to be abandoned, when all the coal is removed that it is possible to remove, and the roof is allowed to settle to the floor. Where conditions are favorable, nearly the whole of the coal in the vein can be removed. The pillars in this case are left about 10 feet thick, and break-throughs are made in them at intervals to provide for the ventilation of the rooms while they are being worked.

The first modification of this method occurs when, for any reason, it is not desirable to keep so much open work standing, on account of bad roof, or where the work is not being developed fast enough to keep up the desired output from the new work. In either of these cases, as soon as the rooms are driven to their destination, the pillars are taken out, or at least so much of them as circumstances will permit, care being taken to leave enough coal near the entries to keep them safe while the work is being carried on beyond the point where the room pillars have been taken out. While this allows the operator

to realize the profits of his development work sooner than the first method, the coal can not be taken out so clean, and the final result is a loss to all concerned in the working of the vein.

In some of our mines, mostly those operating in low or thin veins, instead of keeping up a roadway in each of the entries, only one of each pair is made to serve the purpose of a permanent haulage road. This entry is made of sufficient height by taking roof or bottom along with the coal, and a good haulage road is made along it. Its companion entry is sometimes made only in the coal, and a branch road is laid from the principal entry to each room which is turned from the "air-course," as the second entry is called in such cases. A door is necessary at each of these roads to direct the ventilating current, and, as these are seldom made air-tight, and must be frequently opened to permit the passage of coal and men, this plan usually results in very poor ventilation, the more so as the area of the air-course is so much smaller than that of the entry. In fact, this method has nearly all the disadvantages of the single entry system. This is sometimes modified by making a "cross-cut" between the entries at every third or fourth room. This reduces the number of doors and improves the ventilation to that extent, but I find that the parts of the air-course between those which are used for a roadway are usually allowed to become filled with dirt, thereby choking the air-way and preventing the free circulation of air and requiring a great deal more ventilating power to keep the mine in a fit condition for the men to work in. Also, as the roads in the air-course are abandoned as soon as the rooms are worked out, the proper attention is not given to it to prevent it from being filled up with falling roof, and in a short time it is practically useless as an air-way. This is especially true where the roof is of such a character that it is affected by the action of the air. Where the roof is very much affected by the action of air, and also where it is naturally weak, a modification of the first plan, known as the "block system," is adopted.

In this system, instead of driving entries to the boundary and turning rooms at regular intervals for the whole distance, when the cross-entries have been driven a distance of 100 yards, a pair of entries are started parallel to the rooms and driven to the next cross-entry. When this is done the air may be sent through these entries, and they are also used for haulage-ways, and all but one of the original cross-entries may be abandoned to the point of connection with the cut-off entries, as soon as the coal has been removed from the block formed by the four pairs of entries. The advantage of this plan is that it

avoids the necessity of keeping open so much haulage road and airway, and gives a shorter road for the air to travel. Also where the roof and surface conditions are favorable the coal may be taken out before the conditions have become unfavorable for pillar work.

In some machine mines, while one or the other of the plans outlined above is followed, the rooms are driven double with a road on each side. This is made possible on account of the fact that as the coal is mined by the machines comparatively little powder is used and the roof is not shattered, and so can be more easily kept up by timber than in places where large charges of powder are used to loosen the coal without mining, as is generally done where pick mining is practiced. This method allows all wastage to be thrown into that part of the room between the two roads, and provides for the ventilation of the working places without the necessity of such frequent breakthroughs between the rooms. It also does away with a great deal of the trouble and work in moving the mining machine from one working place to another and adds largely to the amount of work that it may do in a given time.

Other modifications of these plans are made necessary by the varying thickness of the coal in some veins, by the irregular dip and rise of the strata and by the character of the material forming the roof and floor of the mine. In thin veins, in order to save the expense of making the necessary height to permit of mules going to the faces of the rooms, entries are kept as nearly as possible in the "dip" or lowest part of the mine and all rooms are driven to the "raise," so that the mine cars may be brought to the entry by man power. This results in very crooked roadways and a great deal of experimental work, and working places running at all kinds of angles, making it almost impossible for a stranger to see any plan to the workings. In other cases pillars must be a great deal stronger than is given above; in some mines entry pillars are 50 feet thick, and room pillars 20 feet thick. In others entries can not be made more than 6 feet wide, and rooms 15 feet wide. The exigencies of drainage requirements and haulage conditions also have their effect in determining the final shape of the mine, so that although it is easy to plan mining operations as they should be, the person who directs them from day to day finds himself constantly confronted with problems whose successful solution means much to the comfort of the persons employed in the mine and to the financial outcome of the investment of his employer.

MINING MACHINERY.

Mining machinery was introduced into this State in 1884, as a result of a strike at the Currysville Mine, and the mines at Rosedale, Parke County. Having been introduced by force of circumstances, it was demonstrated that the bituminous coal of Indiana could be successfully mined by machinery, and its use has increased until at present a large part of the production of the State is mined by machinery. Originally, only compressed air was used as a motive power, but recent developments in electricity have led to the invention of mining machinery operated by its use. Block coal had not been successfully mined by machinery until 1894, when electric machines were installed at the No. 1 and No. 8 mines of the Brazil Block Coal Company. Since that time they have been successfully operated at those places, but no additional installments have been made in that district. I give a table showing the extent of the use of machinery in this State:

MINES.	COUNTIES.	ELECTRIC.				COMPRESSED AIR.		
		Jeffrey.	Independent.	Morgan-Gardner.	New Morgan.	Jeffrey.	Harrison.	Ingersoll-Sergeant.
Brazil Block Coal Co.'s No. 1.	Clay			12				
Brazil Block Coal Co.'s No. 8.	Clay		5	10	1			
Briar Hill	Clay						4	
Cable No. 9	Daviess			2				
Island City No. 1	Greene						12	
Island No. 2	Greene						24	
Oswalt	Gibson							10
Parke No. 8	Parke						32	
Cox No. 3	Parke						21	1
Lyford No. 2	Parke						7	
Hartwell	Pike			1				
Phenix No. 1	Sullivan						14	
Jumbo	Sullivan						15	
Currysville	Sullivan						6	1
Shelburn	Sullivan					14		
Hymera	Sullivan			7				
Star	Sullivan			6				
Sunnyside	Vanderburgh						1	5
Torrey	Vermillion						12	2
Union	Vigo						7	
Grant	Vigo						8	
Big Vein	Warrick							3
Total			5	38	1	4	53	22

In addition to the above a machine drill is used at Mecca, in Parke County, and two at the Big Vein Mine, in Warrick County. The Indiana & Chicago Coal Company are at work installing an electric plant, which they hope to have in operation before February 1st, as is the New Pittsburgh Coal & Coke Company, at its Phenix mines.

* 12 idle. † 3 of them Lochner.

Mechanical haulage is in use at several mines in this State. A list follows, showing the kind of power used and length of haulage.

MINES.	COUNTY.	KIND OF HAUL-AGE.	POWER USED.	LENGTH.
Island No. 2	Greene	Tail rope	Steam	2,600
Island No. 1	Greene	Tail rope	Steam	1,200
Parke No. 8	Parke	Engine plane	Steam	900
Hymers	Sullivan	Motor	Electricity	1,000
Torrey	Vermillion	Tail rope	Steam	1,200
Ingleside	Vanderburgh	Tail rope	Steam	3,000
Grant	Vigo	Tail rope	Steam	600
Mecca	Parke	Motor	Electricity	2,600

ACCIDENTS.

The following list shows the accidents, fatal, serious and minor, that have been reported to this office, or have by any other means come to the knowledge of my assistant or myself during the year. They consist of 16 fatal, 24 serious and 74 minor accidents. This is a large decrease since 1896, when the list showed 28 fatal, 66 serious and 94 minor accidents. This speaks well for the management of the mines, as the output of coal is nearly equal in the two years, and those affected by the strike were in bad condition when work was resumed, especially where the roof is at all inclined to break and fall from the action of the air. This has usually been a time when accidents were most numerous from various causes, some of which are set out in a circular sent out by this office about the time work was resumed after the strike, in September. A short account of the circumstances attending each fatal accident, as they were developed at the Coroner's inquest in each case, will be found following the list of accidents. With one exception, no charge of negligence could be made against the person in charge of the mine where an accident occurred, and but few where gross carelessness could be imputed to the injured person, or any of his fellow-workmen. A large proportion of them were from causes that were so hidden that they could not have been discovered by the closest observation. The same is true to a less extent in the other classes of accidents, but, as but few of them have been personally investigated by myself or assistant, I am not in a position to make comments upon them.

Fatal Accidents.

DATE.	NAME.	CAUSE.	INJURY.	MINE.	COUNTY.
Jan. 2	Robert Sills	Falling slate	Fatal bruises	Grant	Vigo.
Jan. 27	B. F. Watson	Falling slate	Fatal bruises	Star	Sullivan.
Jan. 28	J. Bristow	Explosion of powder	Fatal bruises	Union	Vanderburgh.
Mar. 16	Wm. Delgeman	Explosion of powder	Fatal bruises	Diamond	Vanderburgh.
May 29	Dd. Williams	Fall of slate	Fatal bruises	Eureka	Clay.
June	Wm. Crawley	Falling slate	Fatal bruises	Nickel Plate	Clay.
Sept. 1	B. Dunville	Falling roof	Fatal bruises	Oswalt	Gibson
Sept. 27	J. Anderson	Powder smoke	Death	Phenix No. 2	Sullivan.
Sept. 27	Geo. Hickson	Electric motor	Death	Phenix No. 2	Sullivan.
Sept. 30	I. N. Williams	Fall in shaft	Broken bones	Parke No. 10	Vigo.
Oct. 1	Geo. Saur	Shot in coal	Bruises and burns	Summit	Greene.
Oct. 5	John Hunter	Fall of slate	Bruises	Fluhart	Greene.
Nov. 13	D. Benzo	Falling roof	Fatal bruises	Brazil B. C. Co. No. 11	Clay.
Nov. 13	A. Miccillitte	Falling roof	Fatal bruises	Brazil B. C. Co. No. 11	Clay.
Nov. 24	Arthur West	Falling slate	Crushed head	Briar Hill	Clay.

Serious Accidents.

DATE.	NAME.	CAUSE.	INJURY.	MINE.	COUNTY.
Jan. 3	John Olson	Railroad car	Finger mangled	Brasil B. C. Co. No. 8	Clay.
Jan. 4	Ben. Dally	Explosion of shot	Body bruises	Brasil B. C. Co. No. 1	Clay.
Jan. 18	F. Jackson	Falling slate	Leg broken	Hector	Vigo.
Feb. 12	Chas. Walter	Falling roof	Spine hurt	Briar Hill	Clay.
Mar. 20	M. Winegar	Fall of slate	Collar bone	Lyford No. 2	Pike.
Mar. 23	N. Cowie	Explosion of fire-damp	Bad burns	Standard	Parks.
Mar. 31	H. Dubney	Fall of coal	Bones broken	Island No. 2	Greene.
April	J. Demont	Draw slate	Antle broken	Island No. 2	Greene.
April	A. Hayman	Descending cage	Leg broken	Lancaster	Owen.
April 18	C. Nicola	Explosion of keg of powder	Badly burned	Pratt	Clay.
May	John Quigley	Fall in shaft	Finger cut off	Standard	Parks.
May 18	John Bain	Mine car	Arm broken	Island No. 2	Greene.
June 3	Wm. Bedford		Leg broken	Hector	Vigo.
June 5	Thos. James		Broken leg	Hector	Vigo.
June 6	Sam Switz	Falling slate	Strained leg	Brasil B. C. Co. No. 1	Clay.
Sept.	A. B. Bayher	Falling slate	Leg broken	Hartwell	Pike.
Sept. 7	J. Thompson	Falling slate	Leg broken	Columbia No. 4	Clay.
Oct.	M. Glover	Falling slate	Leg broken	Brasil B. C. Co. No. 11	Clay.
Oct. 5	Geo. Tischer	Falling slate	Antle mangled	Summit	Greene.
Oct. 15	Jac. Butler	Mule kick	Broken rib	Summit	Greene.
Oct.		Falling slate	Broken limb	Ray	Vigo.
Oct. 26	Lee Wake	Blast	Burns and bruises	Diamond	Clay.
Oct. 27	Joe Williams	Falling slate	Back broken	Brasil B. C. Co. No. 1	Clay.
Nov. 6	Rubin Smith	Falling coal	Bone broken	Louise	Clay.

Minor Accidents.

DATE.	NAME.	CAUSE.	INJURY.	MINE.	COUNTY.
Jan. 11	John Burnett.	Fall of slate	Bruised face	Brazil B. C. Co. No. 11	Clay.
Jan. 11	Chas. Marky	Coal off cars.	Foot mashed	Chandler	Warwick.
Jan. 6	Martin Guy	Falling slate	Bruises	Bicknell	Knox.
Jan. 28	L. Marbeto	Draw slate	Bruises	Brazil B. C. Co. No. 11	Clay.
Jan. 28	Wm. Kehoe	Mine car	Foot hurt	Pratt	Clay.
Jan. 28	Thos. Kehoe	Premature explosion	Burns	Eureka	Clay.
Feb. 20	F. Smith	Explosion	Bad burns	Dugger	Clay.
Feb. 20	Chas. Brown	Mine car	Back bruised	World's Fair	Sullivan.
Feb. 19	H. Ford	Falling slate	Hip bruised	Parke No. 8	Clay.
Feb. 23	John Simas	Fall of slate	Hip bruised	Crawford No. 1	Parke.
Feb. 27	A. W. Witly	Draw slate	Bruised leg	Brazil B. C. Co. No. 8	Clay.
Feb. 27	G. m. Barber	Falling slate	Head cut	Brazil B. C. Co. No. 8	Clay.
Feb. 10	Fred Walters	Draw slate	Bruised leg	Brier Hill	Clay.
Mar. 31	Adam Ehler	Falling slate	Bruises	Cabel No. 9	Davies.
Mar. 26	T. Health	Fall of slate	Bruises	Summit	Greene.
Mar. 26	H. Johnson	Draw slate	Bruises	Parke No. 6	Greene.
Mar. 26	Sam Taylor	Fall of slate	Bruises	Parke No. 6	Parke.
Mar. 26	J. Handthorn	Fall of slate	Bruises	Brazil B. C. Co. No. 8	Parke.
Mar. 26	John Yando	Fall of slate	Bruises	Diamond	Clay.
Mar. 4	John Tuttle	Slate	Toe hurt	Montgomery No. 2	Davies.
Mar. 4	James Barnes	Fall of slate	Bruised face	Island No. 2	Greene.
April 1	Wm. Lundwell	Falling coal	Bruised face	Phenix	Sullivan.
April 27	M. Albright	Mule	Bruised fingers	Brazil B. C. Co. No. 8	Clay.
April 6	L. Dornely	Moving coal	Bruises	Brazil B. C. Co. No. 1	Clay.
April 12	W. m. Morton	Railroad cars	Back hurt	Eureka No. 2	Clay.
April 12	W. m. Morton	Falling slate	Bruised foot	Oswalt	Gibson.
June 12	W. m. Morton	Falling coal	Bruises	Templeton	Greene.
June 9	M. Templeton	Draw slate	Bruises	Prospect	Greene.
June 4	C. Robertson	Explosion of fire-damp	Burns	Brazil B. C. Co. No. 11	Clay.
June 17	Gus Larr	Scales of iron	Eyes burned	Brazil B. C. Co.	Clay.
June 8	Adam Metz	Fall of slate	Bruises	S. W. Little	Pike.
July 13	S. W. Druter	With car	Bruises	Union	Vanderburgh.
Aug. 13	John Muller	Fall of slate	Wrist cut	Oswalt	Vanderburgh.
Aug. 24	J. Kretringer	Fall of slate	Sprained foot	Bicknell	Greene.
Sept. 9	Ben. Hunt	Mine car	Sprained hips	Brazil B. C. Co. No. 8	Knox.
Sept. 20	J. Goodman	Falling coal	Arm cut	Gart No. 5	Clay.
Sept. 20	Geo. Fockner	Mine car	Ankle hurt		
Sept. 2	B. Mckey	Falling slate	Leg hurt		

Minor Accidents—Continued.

DATE.	NAME.	CAUSE.	INJURY.	MINE.	COUNTY.
Sept. 20	G. Everhart.	Machine	Leg hurt.	Brasil B. C. Co. No. 8.	Clay.
Oct. 5	B. Decker.	Mine car.	Bruises.	Blackburn.	Pike.
Oct. 22	Geo. Rife.	Cars off track.	Foot hurt.	Hazel Creek.	Yamhill.
Oct. 2	G. Woodburn.	Mine car.	Toe mashed.	Briar Hill.	Clay.
Oct. 4	J. B. Jones.	Slate in room.	Head hurt.	Crawford No. 2.	Clay.
Oct. 6	Ira Hadley.	Falling coal.	Arm hurt.	Crawford No. 2.	Clay.
Oct. 8	Fred Enour.	Falling coal.	Leg hurt.	Crawford No. 2.	Clay.
Oct. 23	Richard Wake.	Explosion of powder.	Cut on side.	Diamond No. 3.	Clay.
Oct. 24	Geo. Church.	Falling coal.	Foot hurt.	Crawford No. 3.	Clay.
Oct. 14	Jos. Auman.	Mine car.	Leg hurt.	Crawford No. 3.	Clay.
Oct. 3	Mike Conner.	Blast shot.	Burns.	Diamond.	Clay.
Oct. 20	James Patrick.	Falling coal.	Foot hurt.	Brasil B. C. Co.	Clay.
Oct. 23	Chas. Scott.	Fall of coal.	Back and ribs.	Brasil B. C. Co.	Clay.
Nov. 11	Thos. Scully.	Mine car.	Bruised leg.	Star No. 3.	Sullivan.
Nov. 27	J. Cuthbertson.	Falling down shaft.	Eye and bruises.	Diamond No. 3.	Clay.
Nov. 24	Chas. West.	Falling roof.	Cut over eye.	Briar Hill.	Clay.
Nov. 11	Ted Jones.	Falling coal.	Leg hurt.	World's Fair.	Clay.
Oct. 15	Chas. Wilson.	Slate.	Leg hurt.	South Linn.	Greene.
Dec. —	C. R. Carlton.	Draw slate.	Sprained foot.	Cable No. 9.	Greene.
Dec. —	J. Carpenter.	Kicked by mule.	Bruised body.	Brasil B. C. Co. No. 1.	Clay.
Dec. —	H. Nickles.	Fall of draw slate.	Foot mashed.	Brasil B. C. Co. No. 1.	Clay.
Dec. —	A. Campbell.	Falling slate.	Rib broken.	Brasil B. C. Co. No. 1.	Clay.
Dec. —	J. Schanake.	Fall of slate.	Shoulder hurt.	Crawford No. 2.	Clay.
Dec. 1	O. Decamp.	Empty cage.	Bruised back.	Templeton Mine.	Greene.
Dec. 3	T. Templeton.	Relroad car.	Arm hurt.	Gart No. 3.	Clay.
Dec. 9	Christ Brown.	Mine car.	Arm mashed.	Otter Creek, No. 1.	Clay.
Dec. 9	Erwin Young.	Cars on track.	Both arms hurt.	Cox No. 3.	Parke.
Dec. 13	M. Shoemaker.	Mine car.	Five ribs broken.	Cox No. 3.	Parke.
Dec. 18	S. Polovinaki.	Falling slate.	Bruised back.	Brasil B. C. Co. No. 8.	Clay.
Dec. 15	Geo. Dixon.	Draw slate.	Arm hurt.	Dugger.	Sullivan.
Dec. 18	Wm. Burnett.	Draw slate.	Face hurt.	Eureka No. 2.	Clay.
Dec. 28	John Sims.	Hurt by mule.	Face hurt.	Louisa.	Clay.
Dec. —	Wm. Marshal.	Fall of coal.	Leg broken.	World's Fair.	Clay.
Nov. 30	David Palid.	Falling slate.	Leg broken.	World's Fair.	Clay.

COMMENTS ON ACCIDENTS.

As required by law, either myself or my assistant, in conjunction with the Coroner of the county where each death in the mines occurred during the year, made a full investigation as to the cause of each accident resulting in death. I herewith give a brief resume of our findings in each case of fatal accident reported to this office during the year and reported in the above table:

John Sills died January 2d, from injuries received from falling roof in the Grant Mine, in Vigo County. His attention had been called to the dangerous condition of the roof by the mine boss shortly before the accident occurred, but he delayed taking the necessary steps to make it safe until he had finished the work he was engaged in at the time, and before he got ready to attend to it the slate fell, with the result above noted. A large proportion of all the accidents which occur in the mines of this State are caused by delaying to take the precautions which are known to be necessary to render working places reasonably safe, always with the intention of attending to it as soon as some other work of more seeming importance is finished. If workmen and their employers would learn that in all mining operations the unavoidable accidents are quite too frequent, and that safety should be cared for first, we should be called on to chronicle fewer that might have been prevented. In this particular case it seemed, from the evidence, that the deceased was entirely at fault himself, but this is not always the fact by any means.

B. F. Watson was caught under a falling stone on the main traveling way of the Star Mine, in Sullivan County, while on his way to work. From all the evidence obtainable, the roof at the point where the accident happened had been in apparently good condition the evening before, when it was last examined, and other workmen who had preceded Mr. Watson to work that morning had noticed no indications of danger at that point. An examination of the place after the accident by Mr. Epperson, Assistant Inspector of Mines, failed to show any of the usual indications that danger might have been apprehended. It was clearly a case of accident which ordinary foresight could not have prevented.

J. Bristow was fatally injured by the premature explosion of a blast which he had prepared and was in the act of lighting at the Union Mine, in Vanderburgh County. From the testimony of an eye-witness it was learned that he had placed a squib in the needle-hole and was holding the lamp to the match of the squib, but had not yet given

warning of his intention to fire, when the shot exploded. The only reasonable theory to account for the accident is that the squib was defective and that powder had found its way into the match of the squib and become ignited shortly after the match had begun to burn.

Wm. Delgeman was injured at the Diamond Mine, also in Vanderburgh County, in a manner almost identical with the above, as far as could be learned from the testimony available at the inquest. There was no eye-witness in this case, but the decedent had prepared his shot some time before the time for firing, and been engaged in conversation with several of his fellow-workmen when firing time arrived. He left them and went to his working place, and had been there but a few seconds when the explosion occurred. From the position of the body, and his tools, it appeared that he had been in the act of firing his squib when the shot exploded. The squibs used in both of the above instances were what are known as the American brand of patent squibs, and examination of a number of others from the box used by Mr. Delgeman showed several so defective as to have caused the accident, if they had been used in the regular way.

David Williams was working on pillars in the Eureka No. 2 Mine, in Clay County, when the roof gave way and fell on him, inflicting fatal injuries. On investigation it appeared that the particular piece of slate that fell had been loosened by removing coal in the course of his work, and that it would have been impossible for any person to have foreseen the likelihood of an accident in time to have secured the place and prevented the accident.

William Crawley received fatal injuries in the Nickel Plate Mine, in Clay County, under circumstances very similar to the above. A miner who was working near him at the time of the accident testified that before Mr. Crawley began to remove the piece of coal that loosened the slate that fell on him, the place where he was working seemed to be perfectly safe, and that when it was loosened by the removal of the coal it fell without warning. The place where this accident occurred was one in which extraordinary precautionary measures were necessary, as it was at a point where a room had been turned, and top had been taken down on two sides of the block of coal he was mining, and it fell in triangular shape, breaking across from one "loose end" to the other.

Brady Dunville was injured by falling slate in his working place at the Oswalt Mine, in Gibson County. To an experienced miner the indications of danger were sufficient to have given warning of the danger to which he was exposed in ample time to have made the place safe. From the testimony taken in the case it seems that the deceased

had been employed in mines but a short time, and that this fact was known to the company. The only blame that could be attached to any party or person is in allowing an inexperienced man to work in a dangerous place without keeping a careful watch over him. There is too much of this neglect in some parts of the State, and it should be discontinued, either by refusing employment to such as have not sufficient experience in mines to be able to care for themselves, or by allowing them to work only in company with an experienced miner, who should be responsible for the safety of such persons.

David Clark and John Anderson were suffocated by powder smoke in the Phenix No. 2 Mine, in Sullivan County. They and two other men were working a pair of parallel entries and also turning the rooms off them. On the afternoon of the accident their partners had gone home early, leaving the deceased to fire all shots that were to be discharged in both entries. On one of the entries a room was being turned inside of the last break-through. Two shots had been fired in this entry and two others were prepared in the room neck. On returning to fire these shots the men seemed to have lost their way and were overcome by the fumes of the powder already burnt, and were not discovered until about nine o'clock in the evening, when a searching party was organized to learn what had become of them. From the position of the bodies it is surmised that they had both gone into the room to fire the shots, instead of one waiting at the break-through while the other went in. Both had had considerable experience in mines and should have known the risks they were running in going into such a place.

George Hickson was engaged as motorman on an electric locomotive in the Otter Creek Coal Company's Mine at Mecca, in Parke County. While running into the mine with the train of empty cars one of them had, in some way, become uncoupled and remained on the road. When returning with his loaded cars he was riding on the front end of the motor and ran into the empty car on a curve at the bottom of a heavy grade. From the position in which he was found it appears that, after striking the empty car, he had reversed his motor and started to run into the mine again, when the empty car struck him again, crushing him severely and throwing the motor from the track. When discovered he was fastened between the motor and the side of the entry, his leg being caught in that position. The deceased had assisted in installing the electric plant at this mine, and had been in charge of the motor since it had been in use. The accident was caused by his failure to notice the number of cars he had when starting into the face of the mine from the bottom and the number that he had on

arriving at the siding where he exchanged his empties for loads. This would have taken some time, but the result shows that it would have been time well spent.

Isaac N. Williams was the mine boss in charge of the Parke County Coal Company's No. 10 Mine, in Vigo County. The mine had been idle for some time and water had accumulated in it. Pumps were placed on the cages and lowered as the water was taken out. On the day of the accident which caused his death the pumps had not been working well and he had been assisting the engineer to keep them running. He had returned to the mine after supper and remained till nearly midnight, when he told the engineer that he was going home. The engineer went into the boiler room and supposed that Mr. Williams had carried out his intention, but, in fact, in attempting to walk past the shaft he had fallen into it, and was found the next morning lying upon one of the pumps with bruises sufficient upon his body to indicate that he had been killed by the fall, but he was also badly burned by the escape steam from the pump. He had evidently been worn out by the work and worry of the day and had not been in a condition to see where he was going.

Dominic Benzo and Anton Miccillitti were both killed by the same fall of slate in a room in which they were working together at the No. 11 Mine of the Brazil Block Coal Company, near the town of Diamond. The accident occurred in the afternoon as the men were in the act of completing their day's work. One of the men was tamping a hole preparatory to firing and the other was gathering their tools to carry them back out of the way of flying coal. From the evidence of the driver, who had been in the place a few minutes before the accident occurred, the room was well timbered and there were no indications of danger. The fall which caught the men extended entirely across the room back to the row of props nearest the face, and was about three feet in thickness. The position of the bodies indicated that they had made no attempt to escape, and the probabilities are that the fall came without warning. In all my experience in coal mines I never before saw such a fall, and I am of the opinion that before the accident it would have been impossible to foresee the fall of the roof, as it occurred, for any considerable time before it occurred.

Arthur West was killed instantly by a fall of roof in the Briar Hill Mine, near Clay City, in Clay County. While he and his brother were engaged in loading a car of coal a circular or conical piece of slate, known as a "pot," fell from directly over the car, catching the head of the deceased, on a lump of coal which had been placed on the corner of the car crushing his skull. He made no sound after being hit. No

indications of the existence of a pot were visible before the accident, and on being tested the roof appeared to be solid. As this lay directly over the roadway, no props were placed under any part of it. Stones of this character are of frequent occurrence in shale roofs overlying coal seams. They are very dangerous, from the fact that they are separated from the regular strata forming the roof by a thin layer of other material, forming a "slip" on all sides of the pot-shaped stone, which fits so closely that it gives no warning of danger until it suddenly falls without any of the sounds that usually accompany falling roof. Usually, by close examination, the outline of the slip can be detected in the roof material, but in this instance a layer of "draw slate" lay between the coal and the shale forming the roof, and the pot did not show through this. This accident, therefore, must be classed as one caused by the ordinary risks of the miners' occupation.

George Saur lived near Dugger, about four miles from Summit. He and his son worked together and traveled back and forth with a horse and buggy. At about fifteen minutes before firing time he sent his son out to have the team ready to start home when he came out, as he was going to stay and fire two shots, one near the left rib and the other near the middle of the room pointing toward the right rib.

The son waited until after 5 o'clock and, as his father did not come out, he got uneasy, and, with three other miners, went back into the mine to look for him. They found him dead, lying near the right rib of the room, almost covered with large pieces of coal. Both shots had been fired, and the supposition was that the middle shot had caught him, but we had no means of learning how the accident occurred. It is possible that he had fired the shot on the left rib and had gone back and fired the other and got lost in the smoke when starting to run from the second one. It is also possible that he fired both shots at once, as is frequently done, and the middle shot holding fire from a defective squib, or some other reason, he had gone back to it. From the position he was found in, I think the latter was the cause of his death.

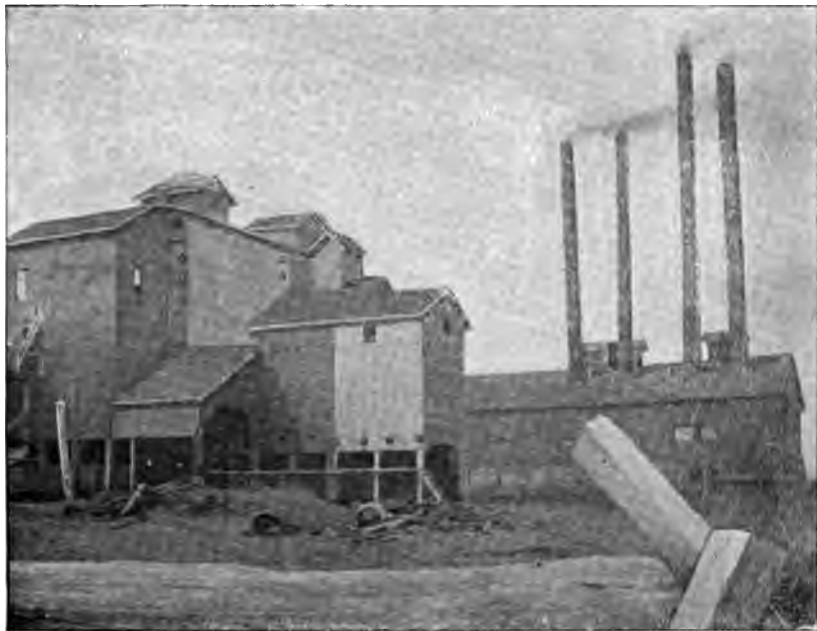
W. M. Hunter, aged 16 years, was working with his father on the morning of October 8th, 1897. At about 9 o'clock he was loading a car, when a large piece of slate fell, catching him with his breast across the car, crushing him terribly and killing him instantly. The timber on the side where the slate fell was back about 11 or 12 feet, while on the other side it was back only about 6 feet. Chas. Hunter, father of the deceased, claims to have examined the slate that morning and thought it safe, but, in my opinion, the condition of the top

was such that it should have been timbered within 6 or 8 feet of the face, as the draw slate is very bad in this part of the mine. There were plenty of timbers on hand in the room.

COAL WASHING MACHINERY IN INDIANA.

All coals have more or less impurities in the vein. These consist principally of slate, sulphur and bone coal, each of which is heavier than the pure coal. In the larger sizes these are easily seen and separated by hand, either in the mine or when the coal reaches the surface, before being shipped to the market; but in the smaller sizes of coal, the impurities being also broken up, are too small to be seen or removed in this manner advantageously. The consequence has been that a great amount of fine coal was useless, fit only for the waste pile, and some of the nut and pea coal produced has lost a great deal of its value on account of the presence of these impurities. This has led inventors to work in the direction of machinery which will remove the impurities from small coal at a reasonable expense. The most successful have taken advantage of the difference in weight, referred to, and separate the materials by the use of water. This has been accomplished in various ways with more or less success. Of the different styles of washers in use are the jig washer, the percussive table, the trough washer, and those in which an upward current of water accomplishes the separation. Washers were originally introduced to clean the coal used in making coke. The superiority of the washed over the unwashed coal for other purposes has led to their introduction at many places to clean coal for the general market. Though very little coke is produced in this State (only the plant at Ayrshire having operated during the year, and that only partially), coal is washed for the market at Alum Cave and Coxville. Extensive improvements were made at the Coxville plant during the year, making it very complete, and, as a short description of the plant and its results may prove interesting to mining men, I give it herewith. The plant is so enclosed that a good photograph of the machinery is not obtainable:

The illustration on the opposite page shows the 400-ton Robinson coal-washing plant, in connection with the coal tippie and screening plant of the Brazil Block Coal Company, at Coxville, Ind., and is the most successful washing plant in this section of the country. The object in washing their nut and pea coal is to eliminate the coal from all impurities, thus creating a greater demand for their coal for commercial purposes. After placing their washed product on the market they



VIEWS OF PLANT OF COX NO. 3 MINE, COXVILLE, INDIANA.

have not only been able to find ready sale for their entire output, but have also been able to increase their price per ton on the washed coal. The installation of this washing plant has been a paying investment and should commend itself to the coal operators of the West.

The method of operating this washing plant in connection with the coal tippie is as follows:

The coal is first dumped over the lump screen; the coal passing into the lump car on railroad track, the screenings passing into the boot of the elevator. This product is then elevated and discharged into a large revolving screen of about $1\frac{1}{2}$ -inch mesh, which is placed over a coal storage pocket. The tailings from this revolving screen is classed as egg or prime nut coal and is picked free from slate as it passes down the chute into the bin. The nut, pea and slack coal that passes through the meshes of this revolving screen is stored into a bin below; from the bottom of this bin a chute is arranged to conduct this product to the Jeffrey-Robinson washer. The coal is then discharged into the center of the washer, on the inside of a deflecting ring, with the current of water to the overflow or discharge spout of the cone tank. The slate, sulphur, sand and other material of greater specific gravity than the coal passes downward into the settling or slate chamber at the bottom of the cone tank. The washer is partially supplied with a fresh current of water pumped from the mine and discharged into a tank below the washer; from this tank the water is pumped by means of two large pulsometer pumps into the lower part of the washer, just above the slate chamber. The accumulation of the slate or refuse is removed from the lower slate chamber by means of valves at stated intervals, which depends entirely upon the per cent. of refuse in the coal. The refuse is deposited into a small mine car and carried to some convenient point and dumped. The good coal is discharged with the water into a revolving screen at the mouth of the washer. This screen is covered with wire cloth of about one-inch mesh. The coal in passing through the screen is thoroughly cleaned and presents a very fine appearance. The tailings or nut coal from this screen is elevated by means of chained buckets into a nut bin; from this bin it is discharged into railroad cars. The pea and slack coal which passes through the revolving screen passes over a fine perforated metal screen set at an angle of about 30 degrees. The material that passes over this screen is classed as pea coal, which is also elevated and discharged into a settling tank; from this tank an overflow pipe is connected to conduct the water back to the water tank below the washer, which is again pumped back into the washer, with the additional supply of

fresh water from the mine. They gather enough fine coal from the settling tank to run their entire battery of boilers, and with this product they are never troubled with clinkers forming over the grate bars.

This plant has been in successful operation for several years. The construction and arrangement of machinery is very simple and effective, and is especially adapted to the washing of coal for commercial purposes. The Jeffrey Manufacturing Company, of Columbus, Ohio, has full control of the manufacture and patents of this Robinson coal-washing system, together with the screening, elevating and conveying machinery, and will promptly answer all inquiries relative to the installation of these plants, for the washing of coal for either commercial or coking purposes.

**REPORT OF THE STATE SUPERVISOR OF
OIL INSPECTION.**

OFFICE OF THE STATE SUPERVISOR OF OIL INSPECTION, }
ROOM 92, STATE HOUSE, }
INDIANAPOLIS, IND. }

PROF. W. S. BLATCHLEY,

State Geologist of Indiana:

DEAR SIR—

I herewith submit to you my third annual report, which shows the number of barrels of oil inspected by myself and deputies during the calendar year, 1897.

This report is made in accordance with the statute providing for the regulation of the use and sale of oils for illuminating purposes within the State.

Yours, truly,

C. F. HALL,

State Supervisor of Oil Inspection.

REPORT OF THE STATE SUPERVISOR OF OIL INSPECTION.

During the year 1897, 268,195½ barrels of illuminating oil were inspected by myself and deputies. Of this number of barrels my deputies and assistants inspected 218,785½, while 49,410 were inspected by myself. But 123 barrels failed to pass the tests, showing that a very high grade of oil is, in general, being shipped into the State.

The standard test for all illuminating oils in Indiana is gravity test, Beaume's hydrometer, not below 46 degrees nor higher than 50 degrees. Said oils must bear a flash test not below 120° Fahrenheit, and a fire test not below 140° Fahrenheit. The reason our rejections are so few is on account of this test being higher than in several other States in the Union, and the lower grades of oil are therefore shipped to them.

No violations of the law regarding oil inspection have come to my notice during the year 1897.

But one or two minor accidents, resulting from the explosion of kerosene, have occurred within the State, and they were due to lamps having been accidentally upset, rather than to the quality of the oil.

From the report it will be seen that the number of stations at which the oil is inspected has largely increased during the year, the number being 89, as against 67 in 1896. This necessitates much more travel on the part of the deputies, with but little additional increase in fees, the number of barrels inspected in the State in 1897 being but 6,045½ greater than in 1896.

The following is a list of Deputy Supervisors in the State on December 31, 1897:

Zaring, Wm. C.....	Evansville.
Weems, Robert F.....	Vincennes.
Dorsey, C. B.....	New Albany.
Bowman, M. J.....	Madison.
Mills, L. B.....	New Maysville.
Shirk, B. F.....	Muncie.
Boltz, J. H.....	Winchester.
Dorsey, W. C.....	Terre Haute.
Carr, W. C.....	Crawfordsville.
McGee, Wm. H.....	Lafayette.
Davidson, James G.....	Whiting.

Johnston, John M.	Logansport.
Daly, W. F.	Peru.
Sebring, W. D.	Portland.
Thorward, Theo.	Fort Wayne.
Schutt, M. A.	Michigan City.
Derr, Walter	South Bend.
Cornell, J. B.	Goshen.

INSPECTION BY STATIONS.

Stations.	Approved.	Rejected.	Total.
Evansville	16,980		16,980
Tell City	626		626
Derby	2		2
Mt. Vernon	4		4
Princeton	1,085		1,085
Huntingburg	728		728
Vincennes	6,584		6,584
Bedford	655		655
Jeffersonville	2,601		2,601
New Albany	3,588		3,588
Madison	4,324		4,324
Seymour	2,143		2,143
Aurora	2,363		2,363
Brookville	1,376		1,376
Greensburg	1,733		1,733
Rushville	1,894		1,894
Shelbyville	1,797		1,797
Batesville	343		343
Franklin	1,743		1,743
Martinsville	988		988
Danville	1,985		1,985
Columbus	2,129		2,129
Bloomington	686		686
Connersville	2,306		2,306
Muncie	1,939		1,939
New Castle	1,380		1,380
Union City	1,800		1,800
Richmond	3,870		3,870
Indianapolis	49,287	123	49,410
Crawfordsville	3,089		3,089
Terre Haute	10,871		10,871
Brazil	2,160		2,160
Rockville	1,946		1,946
Attica	1,495		1,495
Lafayette	9,760		9,760
Frankfort	2,705		2,705
Lebanon	2,018		2,018
Kokomo	2,607		2,607
Fowler	1,380		1,380
Logansport	7,281		7,281
Rochester	1,312		1,312
Delphi	1,150		1,150

INSPECTION BY STATIONS Continued.

Stations.	Approved.	Rejected.	Total.
Whiting	14,103		14,103
Hammond	3,554		3,554
Valparaiso	1,575		1,575
Crown Point	806		806
Porter	399		399
Wabash	1,451		1,451
North Manchester	1,084		1,084
Peru	2,593		2,593
Bluffton	1,810		1,810
Marion	1,562		1,562
Huntington	2,800		2,800
Portland	1,440		1,440
Decatur	1,370		1,370
Columbia City	450		450
Eagle P. O.	5		5
Kendallville	900		900
Garrett	180		180
Fort Wayne	8,189		8,189
Angola	1,710		1,710
Auburn	1,440		1,440
Lagrange	1,080		1,080
Ligonier	630		630
Butler	450		450
South Bend	7,759		7,759
Argos	499		499
Plymouth	1,291		1,291
Bourbon	1,174		1,174
Walkerton	729		729
Goshen	2,582½		2,582½
Elkhart	4,272		4,272
Warsaw	1,281		1,281
Pierceton	602		602
Nappanee	907		907
New Paris	48		48
Michigan City	2,355		2,355
Laporte	2,082		2,082
Knox	357		357
Topeka	360		360
Louisville, Ky.	6,745		6,745
Monckfort, Ky.	2		2
Cincinnati, O.	3,373		3,373
Toledo, O.	1,864		1,864
Lima, O.	5,713		5,713
Mansfield, O.	2,125		2,125
Cleveland, O.	6,608		6,608
Chicago, Ill.	602		602
Danville, Ill.	248		248
Total No. Bbls. inspected for year...	268,072½	123	268,195½

INSPECTION BY MONTHS.

Month.	Approved.	Rejected.	Total.
January	30,845	.....	30,845
February	26,543	.....	26,543
March	20,326	.....	20,326
April	19,423	.....	19,423
May	14,968	.....	14,968
June	13,185	.....	13,185
July	11,192	.....	11,192
August	13,821	.....	13,821
September	22,032	.....	22,032
October	24,824½	.....	24,824½
November	34,076	123	34,199
December	36,837	.....	36,837
Total No. Bbls. inspected by months..	268,072½	123	268,195½

TABLE SHOWING STATES WHERE OIL WAS MANUFACTURED.

Ohio	124,093
Indiana	118,184½
Pennsylvania	25,573
West Virginia	213
Missouri	73
Illinois	44
Kentucky	15
Total for Year by States	268,195½

TABLE SHOWING PLACE OF MANUFACTURE.

Whiting, Ind.....	118,184½
Lima, O.....	104,405
Cleveland, O.....	10,371
Toledo, O.....	7,356
Welker, O.....	1,953
Marietta, O.....	8
Washington, Pa.....	8,220
Oil City, Pa.....	7,293
Pittsburg, Pa.....	4,045
Warren, Pa.....	1,533
Titusville, Pa.....	1,420
Reno, Pa.....	856
Franklin, Pa.....	819
Taylorstown, Pa.....	540
Emlenton, Pa.....	345
Altoona, Pa.....	279
Allegheny, Pa.....	129
South Chester, Pa.....	94
Parkersburg, W. Va.....	213
St. Louis, Mo.....	73
Chicago, Ill.....	44
Carrollton, Ky.....	15
Total	268,195½

Very respectfully,

C. F. HALL.

SEPTEMBER DRAGONFLIES OF ROUND AND SHRINER LAKES, WHITLEY COUNTY, INDIANA.

BY E. B. WILLIAMSON, BLUFFTON, IND.

These lakes have been described by Mr. P. H. Kirsch (Report of Indiana State Fish Commissioner for 1896), so only a remark in this connection is necessary. The diversified character of the shores of these beautiful bodies of water is such that dragonflies of widely varying habits may find here suitable feeding and breeding grounds. Thus the shores of Round Lake, for example, may be divided into sections, each of which may have one or more species that are pretty closely confined to that particular section. The strong flying *Libellula incesta*, during two seasons, has been observed to be at all common only for a short distance along the northern shore of Round Lake. Here the species was very abundant. In the same way *Celithemis eliza* was observed commonly only along the eastern and northeastern shores of Shriner Lake.

By September many of the species which were so common during the earlier summer have disappeared, and more apparent still is the decrease in the number of individuals. In the patch of giant bulrushes where, during July days, myriads of blue and green forms waged defensive and offensive warfare, in September *Lestes vigilax* flutters languidly from stem to stem, or sits with listless wings as though meditating on "days that never come again." On account of this decrease in the number of species and individuals, it happens that some species, which, during the summer months, appeared comparatively common, in the fall come to appear comparatively rare or disappear altogether. During July *Argia putrida* is much more abundant than *Argia violacea*. In September *putrida* is rare and *violacea* is abundant.

The dragonflies mentioned below were observed and collected on September 2, 3 and 4, 1897. In the preparation of the list whenever there has been any doubt as to the identification of species, specimens of such species have been examined and named by Professor Kellicott and Mr. Hine of the Ohio State University.

A LIST OF DRAGONFLIES COLLECTED ON SEPTEMBER 2, 3 AND 4,
ABOUT ROUND AND SHRINER LAKES, WHITLEY COUNTY IN-
DIANA, BY E. B. WILLIAMSON.

1. *Heterina americana* Fabr. Rare, three specimens, one male and two females, taken on Shriner Lake.
2. *Lestes rectangularis* Say. Only one specimen, a male, captured.
3. *Lestes unguiculata* Hagen. Common in patches of *Typha* and *Scirpus lacustris* and *S. americanus*.
4. *Lestes vigilax* Selys. Very common; found in company with *L. unguiculata*; often observed pairing.
5. *Argia putrida* Hagen. Rare.
6. *Argia violacea* Hagen. Abundant; observed pairing.
7. *Ichnura verticalis* Say. A few observed; seen pairing.
8. *Enallagma pollutum* Hagen. Two males were taken.
9. *Enallagma signatum* Hagen. Common, especially about the lily pads, flitting about until after sunset; observed pairing.
- 10.* *Enallagma laterale* Morse. One male.
- 11.† *Enallagma* sp (?) One female.
12. *Anax junius* Drury. Rather rare.
13. *Aeschna constricta* Say. Common; observed pairing.
14. *Tramea lacerata* Hagen. Two young males were taken.
15. *Celithemis eliza* Hagen. Abundant; observed pairing.
16. *Celithemis eponina* Drury. Common; observed pairing.
17. *Celithemis fasciata* Kirb. Rare; one specimen taken at Shriner Lake.
18. *Perithemis domitia* Drury. Common.
19. *Libellula basalis* Say. Common along the northern shore of Round Lake; observed ovipositing.

*I have examined the specimen mentioned, and have compared the abdominal appendages with drawings made for me by Mr. Morse, and I feel sure that the identification is correct.—Prof. D. S. Kellicott.

†The single female is not sufficient to determine the species; there is little doubt but that it belongs to the subgenus *Agrion*. The color is bronze-black with yellow markings; there are large yellow areas on the rear of the head; a broad yellow ante-humeral stripe; sides of thorax yellow with a black line on the second lateral suture, and a half line on the first. The first and second abdominal segments are yellow, each with a dorsal black spot; the third, fourth, fifth, sixth and seventh segments are black except narrowed apical yellow rings; the dorsum of the eighth, ninth and tenth segments is mostly yellow. I think the species is unnamed.—Prof. D. S. Kellicott.

20. *Libellula incesta* Hagen. Common in company with *L. basalis*; observed ovipositing. The males of *L. basalis* persistently attack the females of *L. incesta* which are ovipositing. The males of *L. incesta* at once hasten to protect the females, and royal battles, involving perhaps half a dozen individuals, are thus being constantly waged.
21. *Mesothemis simplicicollis* Say. Common; observed ovipositing, the males always fluttering near. One individual was observed feeding on a *Lestes vigilax*, and another on a *Pamphila*.
22. *Diplax obtrusa* Hagen. Common.
23. *Diplax rubicundula* Say. Rare; one male taken.
24. *Diplax rubicundula assimolata* Uhler. One male captured.
25. *Diplax vicina* Hagen. Very abundant; frequently observed pairing.

A CATALOGUE
OF THE
FOSSILS OF INDIANA,

Accompanied by a Bibliography of the Literature
Relating to Them.

BY EDWARD M. KINDLE.

In the present paper the writer has endeavored to present all of the information which is at present recorded concerning the geological range and distribution within the State of the species listed.

In such a list as the present one, which includes faunas from the Ordovician to the Pleistocene, it has not been possible to do more than present the results of the work of those who have occupied themselves in this field. The list is therefore offered only as a provisional one and as an aid to further study. Many fossils known from other States which are not here listed, as well as new species, will undoubtedly be added in the future; while some species may be found to have been based on incorrectly determined specimens. But it is hoped that it may be useful in aiding other students to add to our present imperfect knowledge of the range and distribution of species within the State, by indicating what has already been accomplished.

The writer wishes to acknowledge here his indebtedness to Prof. W. S. Blatchley for access to the collections of the State Museum, to Prof. H. S. Williams for valuable suggestions, and to Mr. A. C. Benedict for the loan of literature.

PART I. CATALOGUE OF INDIANA FOSSILS.*

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.						QUATERNARY.		
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures.	Drift.
PROTOZOA.												
* <i>Endothyra baileyi</i> Hall. (<i>Rotalia baileyi</i>) Gosport, Greencastle, Owen County and Harrison County (Hall).								✓				
* <i>Fusulina cylindrica</i> Fischer. Lodi (C. A. White), Harrison County.									✓	✓		
<i>Rotalia baileyi</i> — see <i>Endothyra baileyi</i> .												
<i>Moellerina greenii</i> Ulrich. Falls of the Ohio (E. O. Ulrich).				✓								
COELENTERATA.												
<i>Acereula davidsoni</i> E. & H., 11. Jeffersonville (White).				✓								
* <i>Acrophylum oneidaense</i> Billings, 12. Falls of the Ohio (W. J. Davis).				✓								
* <i>Alveolites goldfussi</i> Billings, 11. — Louisville, Ky. (W. J. Davis), Delphi.				✓								
<i>Alveolites indianensis</i> Hall, 11. Delaware County (Phinney).				✓								
<i>Alveolites labiosa</i> Billings. Falls of the Ohio (Rominger).				✓								
* <i>Alveolites megastoma</i> Winch. Falls of the Ohio (Rominger).				✓								
<i>Alveolites squamosus</i> Billings. Falls of the Ohio (W. J. Davis).				✓								
<i>Amplexus cinctatus</i> Miller, 18. St. Paul.			✓									
* <i>Amplexus coralloides</i> Sow. Lanesville.								✓				
<i>Amplexus fragilis</i> White & St. John. Crawfordsville, Providence, and Harrison County.						✓						
<i>Amplexus</i> (?) <i>rockfordensis</i> M. & G. Rockford (Miller & Gurley).						✓						

*NOTE.—Those fossils which are represented in the collections of the State Museum, according to the Sixteenth Annual Report of the State Geologist, are marked in the list with a star.

Numbers following the names of species refer to the volumes of the State Geological Survey which contain the authority for including them in the list. They have been numbered as follows:

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| (1). Geological Report of Indiana, 1837-38 | (11). Geological Report of Indiana, 1881 |
| (2). " " " " " 1859-60 | (12). " " " " " 1882 |
| (3). " " " " " 1869 | (13). " " " " " 1883 |
| (4). " " " " " 1872 | (14). " " " " " 1884 |
| (5). " " " " " 1873 | (15). " " " " " 1885-86 |
| (6). " " " " " 1874 | (16). " " " " " 1888 |
| (7). " " " " " 1875 | (17). " " " " " 1891 |
| (8). " " " " " 1876-78 | (18). " " " " " 1893 |
| (9). " " " " " 1879 | (19). " " " " " 1894 |
| (10). " " " " " 1880 | (20). " " " " " 1895 |

When the State Reports are not cited as the authority for a species, the name of the authority is usually placed in parenthesis after the localities mentioned.

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.								QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rock- ford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures.	Drift.	
* <i>Amplexus shumardi</i> Milne E. Louisville, Ky., and Charlestown (W. J. Davis).		X										
* <i>Amplexus vandelli</i> Milne E., 11. Falls of the Ohio, Madison (Rominger, Cor- nett).			X									
* <i>Astracopongia hamiltonensis</i> M. & W. Clark County.			X									
* <i>Astylopongia burra</i> Hall, 11 Waldron.		X										
<i>Astylopongia imbricato-articulata</i> F. Roem. 11 Waldron.		X										
* <i>Astylopongia praemorsa</i> Hall, 11. Waldron.		X										
<i>Astylopongia praemorsa</i> var. <i>nuxmoschata</i> Hall, 11 Waldron.		X										
<i>Astylopongia stellatum-sulcata</i> Roem. Waldron.		X										
<i>Aulacophyllum convergens</i> Hall, 12 Falls of the Ohio and Clark County.			X									
<i>Aulacophyllum cruciforme</i> Hall, 12. Falls of the Ohio.			X									
<i>Aulacophyllum insigne</i> Falls of the Ohio (W. J. Davis).			X									
<i>Aulacophyllum pinnatum</i> Hall, 12 Falls of the Ohio.			X									
<i>Aulacophyllum poculum</i> Hall, 12. Falls of the Ohio.			X									
<i>Aulacophyllum praecipitum</i> Hall, 12 Falls of the Ohio.			X									
<i>Aulacophyllum princeps</i> Hall, 12. Falls of the Ohio.			X									
<i>Aulacophyllum prateriforme</i> Hall, 12 Falls of the Ohio.			X									
<i>Aulacophyllum reflexum</i> Hall, 12. Falls of the Ohio.			X									
* <i>Aulacophyllum sulcatum</i> d'Orb., 12 Louisville, Ky. (W. J. Davis).			X									
<i>Aulacophyllum tripinnatum</i> Hall, 12 Falls of the Ohio.			X									
<i>Aulacophyllum triuncatum</i> Hall, 12 Charlestown and Falls of the Ohio.			X									
<i>Aulopora arachnoidea</i> Hall Franklin County, Richmond, Madison, (Rom- inger) (W. S. T. Cornett).	X											
<i>Aulopora cornuta</i> Falls of the Ohio (W. J. Davis).			X									
<i>Aulopora edithana</i> Falls of the Ohio (W. J. Davis).			X									
* <i>Aulopora gigas</i> Rominger, 8 Owen County, Crawfordville, Greencastle, Harrison County, Fordice, Lanesville, Washington County, Monroe County.					X	X						
<i>Aulopora precius</i> Hall, 11. Louisville, Ky., Waldron (James Hall) (W. J. Davis).		X										
<i>Aulopora tancevii</i> Hall, 12. Indiana and Kentucky.		X										
<i>Aulopora serpens</i> Goldfuss. Falls of the Ohio (W. J. Davis).			X									
<i>Azophyllum rudis</i> White & St. J., 13. Newport (C. A. White).												
<i>Baryphyllum d'orbigny</i> E. & H. Charlestown.			X									

	ORDOVICIAN	SILURIAN.	DEVONIAN.	CARBONIFEROUS.						QUATERNARY.		
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rock- ford Limestone.	Burlington and Keokuk.	Waraw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures.	Drift.
<i>Chonophyllum cadum</i> Hall, 12. Louisville, Ky.			X									
<i>Cladopora alpenensis</i> Rominger Falls of the Ohio (W. J. Davis).				X								
* <i>Cladopora aspera</i> Rominger Falls of the Ohio.				X								
<i>Cladopora billingsi</i> Louisville, Ky. (W. J. Davis).				X								
* <i>Cladopora cryptodens</i> Bill. Falls of the Ohio.				X								
* <i>Cladopora exposita</i> Rominger Falls of the Ohio (W. J. Davis).				X								
* <i>Cladopora fischeri</i> Billings Falls of the Ohio, Charleston Landing (Rom- inger).				X								
<i>Cladopora imbricata</i> Rominger Falls of the Ohio (Rominger) (Davis).				X								
<i>Cladopora ioeensis</i> Falls of the Ohio (W. J. Davis).				X								
* <i>Cladopora labiosa</i> Billings Falls of the Ohio (W. J. Davis).				X								
* <i>Cladopora laqueata</i> Rominger Falls of the Ohio.			X									
<i>Cladopora lichenoides</i> Rominger Falls of the Ohio (Rominger).				✓								
<i>Cladopora linneana</i> Roming., 11. Shelby County.				✓								
* <i>Cladopora ornata</i> Rominger Clark County.				X								
<i>Cladopora pinguis</i> Falls of the Ohio (W. J. Davis).				X								
<i>Cladopora pulchra</i> Rominger Falls of the Ohio (W. J. Davis).				X								
<i>Cladopora reticulata</i> Hall, 11. Louisville, Ky. (W. J. Davis), Delaware County.			X									
<i>Cladopora rimosa</i> Rominger Falls of the Ohio (W. J. Davis).				X								
* <i>Cladopora robusta</i> Rominger Falls of the Ohio (W. J. Davis), Falls of the Ohio (Rominger).				X								
<i>Cladopora roemeri</i> Louisville, Ky. (W. J. Davis).				X								
<i>Cladopora sarmentosa</i> Hall, 11. Waldron.			X									
* <i>Cladopora verticillata</i> W. & M. Louisville, Ky.			X									
<i>Clisiophyllum conigerum</i> Rominger, 12. Falls of the Ohio.				X								
<i>Clisiophyllum oneidaense</i> Billings, 11 see <i>Acrophyllum oneidaense</i> .												
<i>Coenites crassus</i> Rominger Louisville (W. J. Davis).				X								
<i>Coenites laminatus</i> Hall Louisville (W. J. Davis).				X								
<i>Coenites ramulosa</i> Hall (Rominger).				X								
<i>Coenites verticillata</i> Louisville, Ky. (W. J. Davis).				X								
<i>Coenostroma monticulifera</i> Winch. (Stromatopora monticulifera) Falls of the Ohio.				X								
<i>Coleophyllum pyriforme</i> Hall, 12. Falls of the Ohio (Hall).				X								

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Byrlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Columnaria inaequalis</i> Hall Madison (Cornett).....	X				
<i>Columnopora eribiformis</i> Nich. see <i>Calapoecia eribiformis</i>	X				
<i>Constellaria antheloidea</i> Hall, 11 see <i>Stellipora antheloidea</i>					
* <i>Cyathophyllum arctifossa</i> Hall, 12 Falls of the Ohio.....			X		
* <i>Cyathophyllum brevicorne</i> Rominger Falls of the Ohio (W. J. Davis).....			X		
<i>Cyathophyllum caliculum</i> Osgood (Foerste).....		X			
<i>Cyathophyllum caespitosum</i> Goldfuss Madison.....			X		
<i>Cyathophyllum colligatum</i> Louisville, Ky. (W. J. Davis).....			X		
<i>Cyathophyllum coralliferum</i> Falls of the Ohio (W. J. Davis).....			X		
* <i>Cyathophyllum corniculatum</i> Milne E. 11 Falls of the Ohio (W. J. Davis) Shelby County.....			X		
* <i>Cyathophyllum davidsoni</i> Milne E. 11 Falls of the Ohio (W. J. Davis) Shelby County.....			X		
<i>Cyathophyllum depressum</i> Hall Falls of the Ohio.....			X		
<i>Cyathophyllum exiguum</i> Falls of the Ohio (W. J. Davis).....			X		
* <i>Cyathophyllum geniculatum</i> Rominger Bartholomew County.....			X		
<i>Cyathophyllum halli</i> Falls of the Ohio (W. J. Davis).....			X		
* <i>Cyathophyllum houghtoni</i> Rominger Hartsville.....			X		
<i>Cyathophyllum impositum</i> Hall Falls of the Ohio.....			X		
<i>Cyathophyllum juvenc</i> Rominger, 11 Louisville, Ky. (W. J. Davis) Shelby County.....			X		
<i>Cyathophyllum radícula</i> Rominger Charles-town (Rominger) Louisville Ky. (W. J. Davis).....		X	X		
* <i>Cyathophyllum robustum</i> Falls of the Ohio (W. J. Davis).....			X		
* <i>Cyathophyllum rugosum</i> Milne E., 12 Falls of the Ohio (Rominger) Jackson County, Jennings County and Madison.....			X		
* <i>Cyathophyllum scyphus</i> Rominger, 11 Louisville, Ky. (W. J. Davis), Shelby County.....			X		
<i>Cyathophyllum tornatum</i> Louisville, Ky. (W. J. Davis).....			X		
* <i>Cyathophyllum validum</i> Hall Falls of the Ohio.....			X		
<i>Cyathophyllum vesiculatum</i> Hall Falls of the Ohio.....			X		
<i>Cyclozongria discus</i> Miller Bunker Hill.....			X		
* <i>Cyathophyllum americanum</i> E. & H. Falls of the Ohio (W. J. Davis).....		X	X		
<i>Cystiphyllum caryagaensis</i> Louisville, Ky. (W. J. Davis).....			X		
<i>Cystiphyllum grande</i> Falls of the Ohio (W. J. Davis).....			X		
<i>Cystiphyllum greenii</i> Miller, 18 Falls of the Ohio.....			X		

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.							QUATERNARY.	
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Manassas.	Coal Measures.	Drift.
* <i>Cystiphyllum niagarense</i> Hall, 11. Louisville, Ky. (W. J. Davis), Delaware County.			×									
<i>Cystiphyllum ohioense</i> Nich. Louisville, Ky. (W. J. Davis).				×								
<i>Cystiphyllum pustulatum</i> Hall, 12. Falls of the Ohio.				×								
* <i>Cystiphyllum squamosum</i> Falls of the Ohio (W. J. Davis).				×								
<i>Cystiphyllum sulcatum</i> Billings, 11. Falls of the Ohio (Rominger).				×								
<i>Cystiphyllum vesiculosum</i> Goldf., 11. Falls of the Ohio (W. J. Davis).				✓								
<i>Dendrograptus chaenograptus novellus</i> Hall, 11 Waldron.			×									
<i>Dendropora alternans</i> Louisville, Ky. (W. J. Davis).				×								
<i>Dendropora neglecta</i> Falls of the Ohio (Rominger), Louisville, Ky. (W. J. Davis).				×								
<i>Dendropora proboscidealis</i> Falls of the Ohio (W. J. Davis).					×							
<i>Dictyostruma undulata</i> Nicholson Louisville, Ky. (Nicholson).			×									
<i>Diplotrypa milleri</i> Ulrich. Osgood (Ulrich).			×									
<i>Diphyphyllum adnatum</i> Hall, 12 Falls of the Ohio.				✓								
<i>Diphyphyllum archiaci</i> Bill., 11 Louisville, Ky. (W. J. Davis) Shelby County.				✓								
<i>Diphyphyllum gigas</i> Falls of the Ohio (W. J. Davis).				✓								
* <i>Diphyphyllum apertum</i> Hall, 12 Falls of the Ohio.				✓								
* <i>Diphyphyllum angustum</i> E. & H. Falls of the Ohio (Rominger).				✓								
* <i>Diphyphyllum arundinaceum</i> Billings, 11. Logansport.				✓								
* <i>Diphyphyllum caespitosum</i> Hall. Delphi and Grant County.			×									
* <i>Diphyphyllum huronicum</i> Billings Wabash.			×									
<i>Diphyphyllum panicum</i> Louisville, Ky. (W. J. Davis).				✓								
<i>Diphyphyllum sincoense</i> Billings, 11 Falls of the Ohio (W. J. Davis), Shelby County.				✓								
* <i>Diphyphyllum stramineum</i> Billings, 12. Logansport and Falls of the Ohio.				✓								
<i>Diphyphyllum strictum</i> Falls of the Ohio (W. J. Davis and Nicholson.)				✓								
<i>Diphyphyllum tumidulum</i> Hall, 12 Falls of the Ohio.				✓								
<i>Diphyphyllum verneuianum</i> Louisville, Ky. (W. J. Davis).				✓								
<i>Dryopora intermedia</i> Falls of the Ohio (W. J. Davis).				✓								
<i>Dryopora nobilis</i> Falls of the Ohio (W. J. Davis).				✓								
* <i>Duncanella borealis</i> Nicholson. Hartsville.			×									
<i>Emmonsia cylindrica</i> , 8. Madison (Cornett.)				×								

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Coriferous and Hamilton.	New Albany Shale. Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warraw and St. Louis. Kaskaskia. Man-field. Coal Measures.	Drift.
* Favosites placenta Rominger. Falls of the Ohio (Davis).			×		
* Favosites pleurodictyoides Nicholson. Charlestown.			×		
Favosites polymorpha Goldfuss, II. Madison.			×		
* Favosites radiatus Rominger. Falls of the Ohio, Hartsville (Davis).			×		
* Favosites radiciformis Rominger. Falls of the Ohio (Davis).			×		
Favosites ramosa, 8. Madison.			✓		
* Favosites springer Hall, II. Waldron (James Hall).		×			
* Favosites spongilla Rominger. Louisville (Davis), St. Paul (Rominger).		✓			
* Favosites tuberosus Rominger. Charlestown, Falls of the Ohio (Rominger).			×		
* Favosites turbidatus Billings. Falls of the Ohio.			×		
Favosites venustus Hall, 12. Louisville (Davis).		×			
Favosites winchelli Rominger. Falls of the Ohio (Rominger).			✓		
* Fistulipora acerulosa Rominger. Falls of the Ohio.			✓		
Fistulipora canadensis Billings, 11. (Rominger).			✓		
Fistulipora intercellata Hall. Falls of the Ohio (Hall).			✓		
Glossotrypa paliformis Hall. Falls of the Ohio (Hall).			✓		
* Hadrrophyllum d'orbigny. Louisville, Ky., Clark County (W. J. Davis).			✓		
* Halysites catenulatus Linn., 11. Franklin County (Moore), Wabash County, Carroll County, Huntington County, Os- good (Foerste).		×			
* Halysites labyrinthicus Goldf. Delphi.		✓			
Heliosites interstinctus Linn., 12. Huntington (Rominger).		✓			
Heliosites megastoma McCoy, 11. Louisville (W. J. Davis), Delaware County.		✓			
Heliosites pyriformis Guettard. Louisville (W. J. Davis).			×		
Heliosites subbulatus McCoy. Louisville (W. J. Davis).			×		
Heliosphyllum annulatum Hall, 12. Scott and Clark Counties.			×		
* Heliosphyllum coalitum Rominger, 12. Delphi.			×		
Heliosphyllum compactum Hall, 12. Falls of the Ohio.			×		
Heliosphyllum corniculum Hall, 12. Falls of the Ohio.			×		
Heliosphyllum denticulatum Hall, 12. Falls of the Ohio.			×		
Heliosphyllum distans Hall, 12. Falls of the Ohio.			×		
Heliosphyllum equum Hall, 12. Falls of the Ohio.			×		
* Heliosphyllum crigium Bill., 11. Falls of the Ohio, Shelby County.			×		

	ORDOVICIAN.		SILURIAN.	DEVONIAN.	CARBONIFEROUS.							QUATERNARY.
	Cincinnati.	Clinton.	Niagara and Water Lime.	Coriiferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Taskuska.	Mansfield.	Coal Measures.	Drift.
<i>Lichenalia (Pileotrypa) pyriformis</i> Hall.....				x								
Falls of the Ohio. (Hall).				x								
<i>Lichenalia subacra</i> Hall.....				x								
Falls of the Ohio.				x								
<i>Lichenalia substellata</i> Hall.....				x								
Falls of the Ohio.				x								
<i>Lichenotrypa longispina</i> Hall.....			x									
Falls of the Ohio (Ulrich).												
<i>Linaria ramulosa</i> Hall.....												
see <i>Coenites ramulosus</i> .												
* <i>Lithostroton canadense</i> Castlenau, 8.....								x				
Owen County, Putnam County, Orange County, Harrison County, Montgomery County.												
<i>Lithostroton mamillatus</i> Herzer, 8.....								x				
Harrison County.												
* <i>Lithostroton proliferum</i> Hall, 8.....						x	x	x				
Orange County, Owen County, Monroe County, Putnam County, Harrison County.												
<i>Lophophyllum proliferum</i> McCheaney, 13.....											x	
Throughout the coal measures.												
* <i>Lyellia americana</i> E. & H., 11.....			x?									
Louisville (Davis).												
<i>Lyellia glabra</i>			x	x								
Louisville (Davis).												
* <i>Lyellia papillata</i> Rominger.....			x									
Louisville (Davis).												
* <i>Lyellia parvula</i> Rominger.....			x									
(Rominger).												
* <i>Michelinia clappi</i> (Milne E.) Rominger.....				x								
Falls of the Ohio (Rominger).												
* <i>Michelinia cylindrica</i> E. & H.....				x								
Falls of the Ohio (Davis).												
<i>Michelinia eugeneae</i> White, 13.....											x	
Vermillion County (C. A. White).												
* <i>Michelinia favosidea</i> Billings.....				x								
Falls of the Ohio (Davis).												
* <i>Michelinia insignis</i> Rominger.....				x								
Falls of the Ohio (Rominger).												
<i>Monotrypa subquadrata</i> Ulrich.....	x											
Osgood (Miller), (Ulrich).												
* <i>Monticula approximata</i> Nicholson, 12.....	x											
Madison.												
<i>Monticulipora dalii</i> E. & H., 8.....	x											
Madison (Cornett).												
<i>Monticulipora discoides</i> James (Hall), 12.....	x											
* <i>Monticulipora fibrosa</i> Goldfuss.....	x	x										
North Vernon, Madison (Cornett).												
* <i>Monticulipora filiosa</i> d'Orb.....	x											
Richmond, Madison (James).												
* <i>Monticulipora frondosa</i> d'Orb., 11.....	x											
Madison.												
<i>Monticulipora gracilis</i> James (Hall).....	x											
<i>Monticulipora irregularis</i> d'Orb.....	x											
Hamilton County.												
* <i>Monticulipora jamenti</i> Nich.....	x											
Madison.												
* <i>Monticulipora lycoperdon</i> Say.....	x											
Madison.												
<i>Monticulipora mamulata</i> d'Orb., 12.....	x											

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Indiana.	Clinton. Niagara and Water Lime.	Carboniferous and Hamilton.	New Albany Shale. Knobstone and Rock- ford Limestone. Burlington and Keokuk. Vernon and St. Louis. Cassaskia. Hansfield. Coal Measures Drift.	
<i>Sphenopterium enorme</i> M and N..... see <i>Paleacis enorme</i> .					
* <i>Stellipora antheloides</i> Hall..... Madison (Cornett).	x				
<i>Stenopora fibrosa</i> see <i>Monticulipora fibrosa</i> .					
<i>Stenopora petropolitana</i> Madison (W. S. T. Cornett).	x				
<i>Stomatopora inflata</i> Hall (<i>Hippothoa inflata</i>).... Franklin County (Moore).	x				
<i>Streptelasma (Duncanella) borealis</i> Hall, 11..... Waldron (Hall).		x			
<i>Streptelasma coarctatum</i> Hall, 12..... Louisville Ky.			x		
* <i>Streptelasma crassum</i> Hall..... Richmond.	x				
* <i>Streptelasma corniculum</i> Hall, 11..... Madison, Richmond (Rominger), Franklin County (Moore).	x	x			
<i>Streptelasma inflatum</i> Hall, 12..... Falls of the Ohio.			x		
<i>Streptelasma mammiferum</i> Hall, 12..... Falls of the Ohio.			x		
<i>Streptelasma obliquius</i> Foerste..... Hanover.		x			
<i>Streptelasma papillatum</i> Hall, 12..... Falls of the Ohio.			x		
<i>Streptelasma parvulum</i> Madison (W. S. T. Cornett).	x				
* <i>Streptelasma radicans</i> Hall, 11..... Waldron (Hall), Franklin County (Moore).	x	x			
<i>Streptelasma rusticum</i> Bill..... Richmond, (Wichell and Schuchert).	x				
<i>Streptelasma simplex</i> Hall, 12..... Falls of the Ohio.			x		
* <i>Streptelasma spongioides</i> Rominger..... Hartsville, Grant County, and St. Paul.		x			
<i>Streptelasma tenue</i> Hall, 12..... Falls of the Ohio.			x		
* <i>Striatopora cavernosa</i> Rominger..... Falls of the Ohio.			x		
<i>Striatopora gorbii</i> Miller, 18..... St. Paul.		x			
<i>Striatopora huronensis</i> Rominger..... Falls of the Ohio (Davis).			x		
<i>Striatopora linnaeana</i> Billings, 11..... Falls of the Ohio (Rominger).			x		
* <i>Stromatopora concentrica</i> Goldfuss..... Madison (Cornett).		x	x		
* <i>Stromatopora constellata</i> Hall..... Logansport, Falls of the Ohio.			x		
* <i>Stromatopora densum</i> Nich., 12..... Charlestown.			x		
* <i>Stromatopora granulata</i> Nich..... Falls of the Ohio.			x		
<i>Stromatopora indianensis</i> James..... Connersville (James).	x				
* <i>Stromatopora mammillata</i> Nich..... Clark County.			x		
* <i>Stromatopora monticulifera</i> W. & M..... see <i>Coenostroma monticulifera</i> .					
* <i>Stromatopora nodulata</i> Nich., 11..... Shelby, Clark and Cass Counties.			x		

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Line.	Carboniferous and Hamilton. New Albany Shale.	Knoles and Keokuk Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Zophrentis centralis</i> E. and H., 8. Harrison County.				x	
<i>Zophrentis compressa</i> Rominger, 12. Falls of the Ohio (W. J. Davis).			x		
<i>Zophrentis concava</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis conigera</i> Rominger, 11. Falls of the Ohio (Rominger).			x		
<i>Zophrentis convoluta</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis cornicula</i> Leseur Falls of the Ohio, Charlestown (Rominger), Madison.			x		
<i>Zophrentis cornucopia</i> , 10. Putnam County and Monroe County.				x	
<i>Zophrentis (Amplexus) cruciforme</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis cyathiformis</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis dalei</i> E. and H., Monroe County, Putnam County, Harrison County, Owen County, Greencastle, Craw- fordsville.				x	
<i>Zophrentis davisiana</i> Miller Falls of the Ohio.			x		
<i>Zophrentis declivus</i> Miller New Providence (Miller).				x	
<i>Zophrentis deformis</i> Hall, 12. Charlestown.			x		
<i>Zophrentis duplicata</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis elegans</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis elliptica</i> White, 8. Harrison County, Spergen Hill (R. P. Whit- field).				x	
<i>Zophrentis exiguum</i> Billings Falls of the Ohio.			x		
<i>Zophrentis foliata</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis gibsoni</i> White Vermillion County (C. A. White).					x
<i>Zophrentis gigantia</i> Rafinesque, 11. Madison, Jennings County, Falls of the Ohio (Rominger).					
<i>Zophrentis herzeri</i> Hall, 12. Charlestown.					
<i>Zophrentis nitida</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis nodulosa</i> Rominger Falls of the Ohio (W. J. Davis).			x		
<i>Zophrentis ovalis</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis planima</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis ponderosa</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis profunda</i> Hall, 12. Falls of the Ohio.			x		
<i>Zophrentis prolifica</i> Billings Louisville, Ky. (W. J. Davis).			x		
<i>Zophrentis radicans</i> Louisville, Ky. (W. J. Davis).			x		

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	(Cincinnati.)	Clinton. Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warren and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
* <i>Actinocrinus loricatus</i> Hall, 8. Hindustan, Monroe County, Harrison County.					
<i>Actinocrinus magnifica</i> Troost, 8. Harrison County.					
<i>Actinocrinus meekii</i> Lyon. see <i>Macrostylocrinus meekii</i> .					
<i>Actinocrinus nashvillae</i> Troost, 8. Harrison County.					
* <i>Actinocrinus pernodus</i> Hall. Crawfordsville.					
<i>Actinocrinus ramulosus</i> Hall, 8. see <i>Eretinocrinus ramulosus</i> .					
<i>Actinocrinus unicornis</i> O. & S. see <i>Dorycrinus unicornis</i> .					
<i>Actinocrinus wachsmuthi</i> , 10. see <i>Babocrinus wachsmuthi</i> .					
<i>Aethocystites sculptus</i> Miller, 18. St. Paul.					
<i>Agaricocrinus americanus</i> Rominger, 15. Washington County (Gorby).					
<i>Agaricocrinus odygulus</i> Hall, 15. Washington County (Gorby).					
<i>Agaricocrinus gorbyi</i> Miller, 17. Montgomery County.					
<i>Agaricocrinus indianensis</i> Miller, 17. Washington County.					
<i>Agaricocrinus nodosus</i> M. & W. Washington County.					
<i>Agaricocrinus pentagonus</i> Hall. Washington County.					
<i>Agaricocrinus splendens</i> Miller & Gurley, 16. Crawfordsville (Miller & Gurley).					
<i>Agaricocrinus sprugeti</i> White, 16 and 11. Crawfordsville.					
<i>Agaricocrinus tuberosus</i> Troost, 8. Harrison County.					
* <i>Agaricocrinus wortheni</i> Hall, 8. Washington County.					
* <i>Agassizocrinus conicus</i> Owen & Schward, 8. Harrison County, Orange County (Collett).					
<i>Agassizocrinus conoides</i> , 8. Harrison County (Collett).					
* <i>Agassizocrinus ductyliformis</i> Troost, 8. Harrison County (Collett).					
<i>Agassizocrinus pentagonus</i> Worthen, 8. Reelsville, Putnam County, Orange County, Harrison County.					
<i>Agelaerinus faberi</i> Miller. Osgood and Versailles (M. & F.).					
<i>Agelaerinus squarrosus</i> Meek & Worthen, 16. Crawfordsville and Harrison County.					
<i>Agelaerinus splendens</i> Miller. Crawfordsville.					
* <i>Agelaerinus wortheni</i> Hall. Harrison County, Washington County.					
<i>Alloerinus benedicti</i> Miller, 17. St. Paul.					
* <i>Alloproalloerinus conicus</i> Cassaday & Lyon. Lanesville and Monroe County.					
<i>Ampherostracrinus typus</i> Hall, 11. Waldron.					
* <i>Ampherostracrinus vinnialis</i> ? Hall. Fountain County.					

	ORDOVICIAN.		SILURIAN.	DEVONIAN.	CARBONIFEROUS.						QUATERNARY.	
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures.	Drift.
* <i>Ancyrocrinus bulbosus</i> Hall Falls of the Ohio.				x								
<i>Ancyrocrinus spinosus</i> Hall Clark County.				x								
<i>Archaeocidaris agassizi</i> Hall, 8. Harrison County.						x	x					
* <i>Archaeocidaris keokuk</i> Hall. Bono.						x						
* <i>Archaeocidaris norwoodi</i> Hall, 8. Harrison County.						x						
* <i>Archaeocidaris wortheni</i> Hall, 8. Harrison County and Orange County.						x	x					
<i>Barycrinus elrodi</i> Miller & Gurley. Spergen Hill (Miller & Gurley).							x					
<i>Barycrinus formosus</i> M. & G. Washington County (Miller & Gurley).						x						
* <i>Barycrinus herculeus</i> M. & W., 16. Crawfordsville, Harrison County.						x						
<i>Barycrinus hoveyi</i> Hall, 8 (<i>Cyathocrinus hoveyi</i>), 16. Harrison County, Crawfordsville (Meek & Worthen).						x						
* <i>Barycrinus magister</i> Hall. (<i>Cyathocrinus magister</i>), 8. Harrison County, Spergen Hill & Lanesville (R. P. Whitfield).							x					
* <i>Barycrinus pentagonus</i> Worthen, 8. Harrison County and Crawfordsville.							x					
<i>Barycrinus princeps</i> Miller, 16. Crawfordsville.							x					
<i>Barycrinus sculptiles</i> Hall. (<i>Cyathocrinus sculptiles</i>). Clark County.					x							
<i>Barycrinus spectabilis</i> M. & W., 8. Harrison County.							x					
* <i>Barycrinus stellatus</i> Troost. Crawfordsville.							x					
<i>Barycrinus stellifer</i> Miller, 18. Harrison County.							x					
<i>Barycrinus tumidus</i> Hall. Monroe County.							x					
<i>Barycrinus washingtonensis</i> Miller & Gurley, 27. Washington County (Miller & Gurley).							x					
* <i>Batoerinus aequalis</i> Hall. Smithville.							x					
<i>Batoerinus agnatus</i> Miller, 17. Montgomery County.							x					
<i>Batoerinus arcula</i> Miller & Gurley. Washington County (Miller & Gurley).								x				
<i>Batoerinus asteriscus</i> M. & W., 8. Harrison County.								x				
* <i>Batoerinus biturbinatus</i> Hall. (<i>Actinoerinus biturbinatus</i>). Spergen Hill, Monroe and Harrison Counties (R. P. Whitfield).							x	x				
<i>Batoerinus cantonensis</i> Miller, 16. Canton.								x				
* <i>Batoerinus caroli</i> Hall. Lanesville.									x			
<i>Batoerinus ciatula</i> Miller & Gurley. Lanesville (Miller & Gurley).									x			
<i>Batoerinus crawfordsvillensis</i> Miller, 17. Crawfordsville.										x		
<i>Batoerinus calyculus</i> Hall, 15. Washington County.										x		

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.						QUATERNARY.		
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures	Drift.
<i>Batocrinus decorus</i> Miller, 17. Spergen Hill.								X				
<i>Batocrinus decrepitus</i> , 18. Montgomery County.								X				
<i>Batocrinus facetus</i> Miller, 16. Canton.							X					
<i>Batocrinus icosidactylus</i> Casseday, 8. Spergen Hill, Monroe County, Harrison County (R. P. Whitfield), Greencastle, Washington County.								X				
<i>Batocrinus indianensis</i> Casseday & Lyon (<i>Actinoecrinus indianensis</i>), 16. Crawfordsville, Harrison County, Monroe County and Washington County.						X						
<i>Batocrinus inaequalis</i> Hall, 8. Harrison County.								X				
<i>Batocrinus irregularis</i> Casseday, 8. Spergen Hill, Monroe County, Washington County, Harrison County.								X				
<i>Batocrinus fucundus</i> Miller & Gurley, 16. Crawfordsville (Miller & Gurley).						X						
<i>Batocrinus lagunculus</i> Hall (<i>Actinoecrinus lagunculus</i>) Washington and Monroe counties.								X				
<i>Batocrinus marinus</i> Miller & Gurley, 16. Crawfordsville (Miller & Gurley).						X						
<i>Batocrinus montgomeryensis</i> Worthen. Crawfordsville (A. H. Worthen).						X						
<i>Batocrinus mundulus</i> (?) Hall. Washington County.						X	X					
<i>Batocrinus pileus</i> Miller & Gurley. Washington County (Miller & Gurley).								X				
<i>Batocrinus pistillum</i> M. & W., 15. Washington County and Edwardsville.						X						
<i>Batocrinus plano-discus</i> Hall, 15. Washington County, Bono.						?	X					
<i>Batocrinus pyriformis</i> Schumard. Washington County.								X				
<i>Batocrinus sacculus</i> Miller & Gurley. Washington County (Miller & Gurley).								X				
<i>Batocrinus spergeni</i> Miller, 17. Spergen Hill.								X				
<i>Batocrinus wachsmuthi</i> White (<i>Actinoecrinus wachsmuthi</i>), 16. Crawfordsville.							X					
<i>Batocrinus ichiti</i> Wachs. & Spr. Bono (Wachs. & Springer).							X					
<i>Calceocrinus?</i> <i>bradleyi</i> Meek. see <i>Deltaecrinus bradleyi</i> .												
<i>Calceocrinus indianensis</i> Miller, 17. St. Paul and Jefferson County.			X									
<i>Calceocrinus nodosus</i> Hall. see <i>Deltaecrinus nodosus</i> .												
<i>Calceocrinus stigmatus</i> Hall, 11. see <i>Deltaecrinus stigmatus</i> .												
<i>Callierinus beaumonti</i> W. & S. St. Paul (Wachs. & Spr).			X									
<i>Caryocrinus ellipticus</i> Miller & Gurley. Osgood (Miller & Gurley).			X									
<i>Caryocrinus ornatus</i> Say. Madison, Jennings County, Utica, Clark County and Ripley County.	X	X	X	X								
<i>Catilloecrinus bradleyi</i> M. & W., 8. Harrison County, Crawfordsville.						X	X					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.						QUATERNARY.		
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton	New Albany Shale	Knobstone and Rockford Limestone e.	Burlington and Keokuk.	Warsaw and St Louis	Kaskaskia.	Manassett.	Coal Measures	Drift.
<i>Ophidocrinus (?) indianensis</i> Mill. & G. St. Paul (Miller & Gurley).			x									
<i>Ophidocrinus gorbys</i> Miller, 18. St. Paul.			x									
<i>Dendrocrinus ancilla</i> Hall, 11. Waldron.			x									
* <i>Dendrocrinus polydactylus</i> Shumard (Homocrinus polydactylus) Richmond, Madison and Franklin Counties (Shumard).	x											
<i>Dichocrinus constrictus</i> M. & W., 8. Monroe County, Harrison County and Washington County.								x				
<i>Dichocrinus cornigerus</i> Shumard, 8. Harrison County.									x			
<i>Dichocrinus dichotomus</i> Hall, 15. Washington County.								x				
* <i>Dichocrinus expansus</i> M. & W. Harrison County.							x					
* <i>Dichocrinus flexus</i> Cassaday & Lyon, 16. Harrison County, Montgomery County, Crawfordsville (C. & L.).							x	x				
<i>Dichocrinus lineatus</i> M. & W., 8. Harrison County.							x	x				
<i>Dichocrinus pinum</i> Meek & Worthen, 8. Harrison County.								x				
<i>Dichocrinus polydactylus</i> Cassaday & Lyon, 16. Montgomery County (Cassaday & Lyon).							x					
<i>Dichocrinus sculptus</i> C. & L., 10. Monroe County.							x					
<i>Dichocrinus sexlobatus</i> Shumard, 8. see <i>Talarocrinus sexlobatus</i> .							x	x				
* <i>Dichocrinus simplex</i> Shumard, Harrison County, Bloomington, Washington County, Monroe County, Spergen Hill (Whitfield).							x					
<i>Dichocrinus spinifera</i> , 10. Reelsville, Putnam County.									x			
<i>Dichocrinus striatus</i> O. & S., 8. Harrison County.							x					
<i>Dichocrinus ulrichi</i> Miller, 16. Bono.							x					
<i>Dolatocrinus amplus</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Dolatocrinus aplatus</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Dolatocrinus approximatus</i> (Miller & Gurley) Louisville, Ky. (Miller & Gurley).				x								
<i>Dolatocrinus argutus</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Dolatocrinus bellulus</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Dolatocrinus bellarugosus</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Dolatocrinus bradleyi</i> (Calceocrinus bradleyi), 16. Crawfordsville (Meek).				x			x					
<i>Dolatocrinus bulbaceus</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Dolatocrinus caelatus</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Dolatocrinus charlestownensis</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Dolatocrinus corporosus</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.					QUATERNARY.			
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Sha.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warren and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures.	Drift.
* <i>Eucalyptocrinus crassus</i> Hall, 11. Miami County, Waldron (James Hall).			x									
<i>Eucalyptocrinus ellipticus</i> Miller, 17. Hartsville.			x									
* <i>Eucalyptocrinus elrodi</i> Miller, 17. Hartsville, Waldron (Gorby).			x									
* <i>Eucalyptocrinus ovalis</i> Hall, 11. Waldron (James Hall).			x									
* <i>Eucalyptocrinus splendidus</i> Troost. Charlestown.			x									
<i>Eucalyptocrinus subglobosus</i> Miller, 17. Hartsville.			x									
<i>Eucalyptocrinus tuberculatus</i> Miller & Dyer. Waldron (Miller & Dyer).			x									
<i>Eupachyrinus boydi</i> (Meek & Worthen), 8. Harrison County.									x			
<i>Exactinopora grandis</i> M. & W., 8.												
<i>Exactinopora serradinta</i> M. & W., 8. Harrison County.							x					
<i>Forbesocrinus meeki</i> Hall, 8. see <i>Taxocrinus meeki</i> .												
<i>Forbesocrinus ramulosus</i> Hall, 8. see <i>Taxocrinus ramulosus</i> .												
<i>Forbesocrinus shumardianus</i> Hall, 8. see <i>Taxocrinus shumardianus</i> .												
<i>Forbesocrinus speciosus</i> Miller, 16. Washington County.							x					
<i>Forbesocrinus washingtonensis</i> Miller & Gurley. Washington County (Miller & Gurley).							x					
<i>Forbesocrinus wortheni</i> Hall, 16. Spergen Hill, Harrison County, Crawfordsville (Whitfield).							x	x	x			
<i>Gazacrinus inornatus</i> Miller, 18. St. Paul.			x									
<i>Gennaeocrinus cornigerus</i> L. & C. (<i>Actinoecrinus kentuckensis</i>). Clark County.				x								
<i>Gilbertocrinus greeni</i> Miller & Gurley. Charlestown (Miller & Gurley).				x								
<i>Gilbertocrinus indianensis</i> M. & G. Charlestown (Miller & Gurley).				x								
* <i>Glyptaster inornatus</i> Hall, 11. Waldron (James Hall).			x									
<i>Glyptaster occidentalis</i> Hall, 11. Waldron.			x									
* <i>Glyptaster occidentalis</i> var. <i>crebescens</i> Hall, 11. Waldron (James Hall).			x									
<i>Glyptocrinus baeri</i> Meek. see <i>Xenocrinus baeri</i> .												
<i>Glyptocrinus carleyi</i> Hall, 11. see <i>Mariacrinus carleyi</i> .												
* <i>Glyptocrinus deceductylus</i> Hall. Madison (?) (Meek.).	x											
* <i>Glyptocrinus dyeri</i> Meek. Madison.	x											
<i>Goniasteroidocrinus lyonanus</i> M. & G. Indian Creek, near Crawfordsville (Miller & Gurley).						x						
* <i>Goniasteroidocrinus tuberosus</i> L. & C., 17. Crawfordsville.						x						
<i>Granatocrinus curtis</i> Shumard, 15. Washington County.								x				

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Coniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Holocystites rotundus</i> Miller..... Ripley County (Miller).		X			
<i>Holocystites scitulus</i> Miller, 17..... Jefferson County.		X			
<i>Holocystites spangleri</i> Miller, 17..... Jefferson County.		X			
<i>Holocystites sphaeroidalis</i> M. & G..... Madison (Miller & Gurley).		X			
<i>Holocystites splendens</i> M. & G..... Madison (Miller & Gurley).		X			
<i>Holocystites subopatus</i> Miller, 17..... Jefferson County.		X			
<i>Holocystites subrotundus</i> Miller..... Ripley County (Miller).		X			
<i>Holocystites tumidus</i> Miller..... Ripley County (Miller).		X			
<i>Holocystites turbinatus</i> Miller..... Osgood and Ripley County (Miller).		X			
<i>Holocystites ventricosus</i> Miller..... Ripley County (Miller).		X			
<i>Holocystites wetherbyi</i> Miller..... Ripley County (Miller).		X			
<i>Holocystites wykoffi</i> Miller, 17..... Jefferson County.		X			
<i>Homocrinus polydactylus</i> see <i>Dendrocrinus polydactylus</i> .					
<i>Hydreioocrinus armiger</i> M. & W., 8..... (<i>Zeacrinus armiger</i>) Harrison County.				X	
<i>Hydreioocrinus mucrospinus</i> McChesney..... (<i>Zeacrinus mucrospinus</i>) Rush Creek (Mc- Chesney).					X
<i>Hyptiocrinus typus</i> W. & S..... St. Paul (Wachs. & Spr.).		X			
<i>Ichthyocrinus clarkensis</i> Miller & Gurley..... Clark County (Miller & Gurley).				X?	
* <i>Ichthyocrinus simplex</i> Hall..... Waldron.		X			
<i>Ichthyocrinus spinosulus</i> Miller & Gurley..... Clark County (Miller & Gurley).			X		
<i>Ichthyocrinus subangularis</i> Hall, II..... Waldron (James Hall).		X			
<i>Ichthyocrinus pusillus</i> (?) Hall..... Waldron (J. Hall).		X			
<i>Idiocrinus elongatus</i> W. & S..... St. Paul (Wachs. & Spr.).		X			
<i>Idiocrinus subcrassus</i> Meek & Worthen..... Heterocrinus subcrassus (W. S. T. Cornett).	✓				
<i>Idiocrinus ventricosus</i> W. & S..... St. Paul (Wachs. & Spr.).		X			
<i>Indianoocrinus punctatus</i> M. & G..... St. Paul (Miller & Gurley).		X			
<i>Lampteroocrinus parvus</i> Hall, II..... Waldron.		X			
<i>Lecanoocrinus greenei</i> Miller & Gurley..... Louisville, Ky. (Miller & Gurley).		X			
* <i>Lecanoocrinus pusillus</i> Hall, II..... Waldron (James Hall).		X			
<i>Lepidocrinus moorei</i> Meek..... Richmond (Meek).	X				
<i>Lepidesthes colletti</i> White, 16..... Crawfordsville, Washington County, Salem and Harrison Counties (C. A. White).				X X	
<i>Lepidesthes coreyi</i> M. & W., 16..... Crawfordsville (Meek & Worthen).				X	

	ORDOVICIAN	SILURIAN.	DEVONIAN.	CARBONIFEROUS.						QUATERNARY.		
	Cincinnati.	Clinton.	Niagara and Water Lime.	Coniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Munsfield.	Coal Measures.	Drift.
* <i>Lichenocrinus dyeri</i> Hall.....	✓											
Ripley County.												
<i>Lichenocrinus pattersoni</i> Miller.....	✓											
Versailles (?) (Miller).												
<i>Lichenocrinus tuberculatus</i> Miller.....	✓											
Ripley County, three miles south of Osgood (Miller).												
<i>Lyrioecrinus melissa</i> Hall, 11 (<i>Rhodoecrinus melissa</i>).....		✓										
(James Hall).												
* <i>Macrostylocrinus fasciatus</i> Hall, 11.....		✓										
Waldron (James Hall).												
<i>Macrostylocrinus indianensis</i> M. & G.....		✓										
St. Paul (Miller & Gurley).												
<i>Macrostylocrinus meeki</i> Lyon (<i>Actinoecrinus meeki</i>).....		✓										
Utica, Clark County.												
* <i>Macrostylocrinus ornatus</i> Hall.....		✓										
Waldron (James Hall).												
<i>Macrostylocrinus striatus</i> Hall, 11.....		✓										
Waldron.												
* <i>Macrostylocrinus striatus</i> var. <i>granulosus</i> Hall, 11.....		✓										
Waldron (James Hall).												
<i>Mariaecrinus aureatus</i> Miller, 17.....		✓										
St. Paul.												
<i>Mariaecrinus carleyi</i> Hall (<i>Glyptocrinus carleyi</i>).....		✓										
Waldron (James Hall).												
<i>Mariaecrinus granulosus</i> Miller, 17.....		✓										
St. Paul.												
* <i>Mariaecrinus obconicus</i> Hall.....		✓										
Waldron and Clark County.												
* <i>Marsupioecrinus tennesseensis</i> Roemer.....		✓										
Delphi.												
<i>Megistocrinus abnormis</i> Lyon (<i>Actinoecrinus abnormis</i>).....		✓										
Clark County and Falls of the Ohio (Lyon).												
<i>Megistocrinus expansus</i> Miller & Gurley.....		✓										
Louisville, Ky. (Miller & Gurley).												
<i>Megistocrinus hemisphericus</i> M. & G.....		✓										
Clark County (Miller & Gurley).												
<i>Megistocrinus knappi</i> (Lyon & Cassaday).....		✓										
Falls of the Ohio (Lyon).												
<i>Megistocrinus ornatus</i> Miller & Gurley.....		✓										
Clark County (Miller & Gurley).												
* <i>Megistocrinus rugosus</i> L. & C.....		✓										
Clark County, Falls of the Ohio.												
<i>Megistocrinus spinosulus</i> Lyon.....		✓										
Falls of the Ohio (Lyon).												
<i>Melocrinus equalis</i> Miller, 18.....		✓										
St. Paul.												
<i>Melocrinus obconicus</i> Hall, 11.....		✓										
Utica, Clark County, Waldron (James Hall).												
<i>Melocrinus oblongus</i> W. & S.....		✓										
St. Paul (Wachs. & Spr.).												
<i>Melocrinus parvus</i> W. & S.....		✓										
St. Paul (Wachs. & Spr.).												
<i>Melonites indianensis</i> M. & G.....		✓										
Greenville, Harrison Co. (Miller & Gurley.)												
* <i>Melonites multiporis</i> Owen & Norwood, 3.....		✓										
Harrison County.												
<i>Nucleocrinus angularis</i> Lyon (<i>Olivianites angularis</i>).....		✓										
Falls of the Ohio.												

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.							QUATERNARY.
	Cincinnati.	Clinton Niagara and Water Lime.	Coniferous and Hamilton.	New Albany Shale.	Knobstone and Rock- ford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures.	Drift.
<i>Nucleocrinus greeni</i> M. & G. Louisville, Ky. (Miller & Gurley).			X								
* <i>Nucleocrinus verneuili</i> Troost (<i>Olivianites verneuili</i>) Falls of the Ohio.			X								
<i>Nucleocrinus venustus</i> M. & G. Louisville, Ky. (Miller & Gurley).			X								
* <i>Oligoporus danae</i> M. & W. Lawrence County.					X						
* <i>Oligoporus nobilis</i> M. & W., 8. Harrison County and Greencastle.					X						
<i>Olivianites angularis</i> Lyon see <i>Nucleocrinus angularis</i> .											
<i>Olivianites verneuili</i> Troost. see <i>Nucleocrinus verneuili</i> .											
<i>Oloocrinus tuberosus</i> Lyon & Cass., 16. Crawfordsville.					X						
<i>Onychaster flexilis</i> M. & W., 16. Crawfordsville, Harrison County, Meek & Worthen.					X						
<i>Onychocrinus cantonensis</i> Miller, 16. Canton.					X						
* <i>Onychocrinus exculptus</i> (Lyon & Casseday), 16 and 11. Washington County and Montgomery County (L. & C.), Crawfordsville.					X						
<i>Onychocrinus parvus</i> M. & G. Shoals, Martin County (Miller & Gurley).											
* <i>Onychocrinus ramulosus</i> L. & C., 16 and 11. Crawfordsville.					X						
<i>Onychocrinus ulrichi</i> Miller & Gurley, 16. Crawfordsville (Miller & Gurley).					X						
<i>Onychocrinus whitfieldi</i> Hall, 8. Harrison County.											
<i>Palaeaster crawfordsvillensis</i> Miller. Crawfordsville (Miller).											
<i>Palaeaster speciosa</i> M. & D. Richmond (James).											
<i>Palaeaster wykoffi</i> M. & G. Madison (Miller & Gurley).											
* <i>Pentremites burlingtonensis</i> M. & W., 8. Harrison County, Hindostan, Monroe County					X						
* <i>Pentremites calycinus</i> Lyon Orange County.											
* <i>Pentremites cervinus</i> Hall. Orange County.											
* <i>Pentremites cherokeus</i> Troost. Orange County.											
* <i>Pentremites conoides</i> Hall, 12 and 10. Owen County, Montgomery County, Harrison County, Washington County, Greencastle, Spargen Hill, Bloomington, Jackson Co.											
<i>Pentremites globosus</i> Say, 8. Harrison County.											
* <i>Pentremites godoni</i> DeFrance, 8 and 10. Reelsville, Putnam County, Harrison County, Owen County, Clay County, Orange County, Dubois, Crawford.?								X			
<i>Pentremites grosveneri</i> Shumard. see <i>Troostocrinus grosveneri</i> .								X			
* <i>Pentremites koninckianus</i> Hall, 12. Monroe County, Greencastle, Spargen Hill, Bloomington, Washington County and Harrison County (Hall).											

	Cincinnati.	Ordovician.	Clinton.	Silurian.	Devonian.	Carboniferous.	Quaternary.
			Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Kankakee. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
* <i>Platycrinus saras</i> Hall.....							
Lanesville.							
* <i>Platycrinus siluricus</i> Hall, 11.....			X				
Waldron.							
<i>Platycrinus subspinosus?</i> Hall, 8.....							
Harrison County.							
* <i>Platycrinus yandelli</i> Owen & Shumard, 7.....						X	
Crawfordsville (Collett).							
<i>Poteriocrinus amoenus</i> Miller, 17.....						X	
Montgomery.							
<i>Poteriocrinus arcuus</i> Miller, 16.....						X	
Washington County.*							
<i>Poteriocrinus biselli</i> Worthen, 8.....							
Harrison County and Orange County.						X	
<i>Poteriocrinus calyx</i> Hall, 11.....			X				
Waldron.							
<i>Poteriocrinus cantonensis</i> Miller, 16.....						X	
Canton.							
<i>Poteriocrinus cusi</i> Meek.....	X						
Richmond (Meek).							
<i>Poteriocrinus chesterensis</i> Meek & Worthen, 8.....							
Harrison County.						X	
<i>Poteriocrinus circumtextus</i> M. & G.....						X	
Crawfordsville (Miller & Gurley).							
<i>Poteriocrinus concinnus</i> M. & W., 16.....						X	
Crawfordsville (Meek & Worthen).							
* <i>Poteriocrinus coreyi</i> Worthen, 16.....						X	
Crawfordsville.							
<i>Poteriocrinus coryphaeus</i> Miller, 17.....						X	
Montgomery County.							
<i>Poteriocrinus crawfordavillensis</i> Miller & Gurley, 16.....						X	
Crawfordsville (Miller & Gurley).							
<i>Poteriocrinus davisianus</i> Miller.....				X			
Deputy (Miller).							
<i>Poteriocrinus depressus</i> M. & W., 16.....						X	
Crawfordsville.							
<i>Poteriocrinus dicaricatus</i> Hall, 15.....						X	
Washington County.							
<i>Poteriocrinus gibsoni</i> White, 16.....						X	
Crawfordsville.							
<i>Poteriocrinus grandis</i> W. & S., 16.....						X	
Crawfordsville.							
<i>Poteriocrinus granilineus</i> Miller & Gurley, 16.....						X	
Crawfordsville (Miller & Gurley).							
<i>Poteriocrinus gurleyi</i> White, 16.....						X	
Crawfordsville.							
* <i>Poteriocrinus horeyi</i> Worthen.....						X	
Crawfordsville.							
* <i>Poteriocrinus indianensis</i> M. & W., 16.....						X	
Harrison County and Crawfordville.							
<i>Poteriocrinus missouriensis</i> Shumard, 8.....						X	
Harrison County.							
<i>Poteriocrinus nattelrothanus</i> Miller.....				X			
Deputy (Miller).							
<i>Poteriocrinus nodobrachiatus</i> H., 16.....						X	
Crawfordsville.							
* <i>Poteriocrinus penecliformis</i> Worthen.....						X	
Crawfordsville.							
<i>Poteriocrinus (Dendocrinus) polydactylus</i> (Shu- mard).....						X	
see <i>Homocrinus polydactylus</i> .							
<i>Poteriocrinus robustus</i> H., 16.....						X	
Crawfordsville.							

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water-Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rockford Limestone. Burlington and Keokuk. Waverly and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Scaphiocrinus nodobranchiatus</i> Hall, 7..... Crawfordsville.				x	
<i>Scaphiocrinus porrectus</i> Miller?..... Crawfordsville.		x			
<i>Scaphiocrinus praeformis</i> Miller, 16..... Washington County.				x	
<i>Scaphiocrinus repertus</i> Miller, 16..... Bono.				x	
* <i>Scaphiocrinus robustus</i> Hall, 17..... Crawfordsville (Hall).				x	
<i>Scaphiocrinus unicus</i> Hall, 8..... Crawfordsville, Harrison County.				x	
<i>Scaphiocrinus wachsmuthi</i> , <i>see Graphiocrinus wachsmuthi</i> .					
<i>Steganoecrinus benedicti</i> Miller, 18..... Canton, Washington County.				x	
<i>Steganoecrinus spargensis</i> M. & G., Spergen Hill (Miller & Gurley).					
<i>Stenaster grandis</i> Meek..... Richmond (Meek).	x				
<i>Stephanocrinus cornetti</i> Miller, 18..... Madison.		x			
<i>Stephanocrinus elongatus</i> Miller, 17..... Madison.		x			
<i>Stephanocrinus gemmiformis</i> Hall, 11..... Waldron (James Hall).		x			
<i>Stephanocrinus hammelli</i> Miller, 17..... Madison.		x			
<i>Stephanocrinus hyppyramidalis</i> Miller, 17..... Madison.		x			
<i>Stephanocrinus osgoodensis</i> Miller 17..... Osgood and Madison (Miller).		x			
<i>Stereoecrinus indianensis</i> M. & G., Charlestown (Miller & Gurley).		x			
<i>Stribalocystites gureyi</i> Miller, 18..... St. Paul.		x			
<i>Stribalocystites tumidus</i> Miller, 17..... St. Paul.		x			
<i>Stribalocystites sphaeroidalis</i> M. & G., St. Paul (Miller & Gurley).		x			
<i>Strotoecrinus perumbrosus</i> Hall, 8..... Harrison County.		x			
<i>Synbathocrinus dentatus</i> , O. & S., 8..... Harrison County.		x			
<i>Synbathocrinus openi</i> Hall..... Rockford (James Hall).		x		x	
<i>Synbathocrinus?</i> <i>robustus</i> Shumard, 8..... Harrison County.		x		x	
* <i>Synbathocrinus scallopi</i> Hall, 8..... Harrison County, Spergen Hill (Whitfield).		x		x	
<i>Synbathocrinus wachsmuthi</i> M. & W., 8..... <i>see Catillocrinus wachsmuthi</i> .		x		x	
<i>Synbathocrinus wortheni</i> Hall, 8..... Harrison County.		x		x	
<i>Talarocrinus cornigerus</i> Shumard..... Harrison County.				x	
* <i>Talarocrinus sexlobatus</i> Shumard..... (<i>Dichocrinus sexlobatus</i>) Harrison County and Crawford County.				x	
<i>Taxocrinus crassifordensis</i> M. & G., Crawfordsville (Miller & Gurley).				x	
* <i>Taxocrinus meeki</i> Hall..... (<i>Forbesocrinus meeki</i>) Harrison County.				x	

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Manassas. Coal Measures.	Drift.
<i>Zenocrinus troostianus</i> M. & W., 8 Harrison County.				✓	
<i>Zophocrinus howardi</i> Miller, 17 St. Paul.		×			
VERMES.					
<i>Cornulites elevata</i> COZZENS. (Cozzens).			×		
* <i>Cornulites proprius</i> Hall, 11. Waldron (James Hall).		×			
<i>Ortonia minuta</i> Madison (W. S. T. Cornett).	×				
<i>Spirorbis annulatus</i> Hall, 12. Spergen Hill, Bloomington, Harrison and Washington Counties.				×	
<i>Spirorbis annulatus</i> var. <i>nodulosus</i> Spergen Hill (Hall).				✓	
<i>Spirorbis carbonarius</i> Dawson. Newberg.					×
<i>Spirorbis inornatus</i> Hall, 11. Waldron (James Hall).		×			
<i>Spirorbis nodulosus</i> Hall, 12. Spergen Hill and Lanesville.				✓	
MOLLUSCOIDEA.					
Brachyzoa.					
<i>Archimedes arcticus</i> (Ehrbridge)				✓	
* <i>Archimedes loxus</i> Hall, 11 and 8 Harrison County.				✓	
<i>Archimedes meekianus</i> Hall. Orange County and Crawfordsville.				×	
* <i>Archimedes ovcenanus</i> Hall, 16. Greencastle, Montgomery County, Craw- fordsville, Owen County and Harrison County.				✓	
* <i>Archimedes reversus</i> Hall, 16. Crawfordsville, Harrison County and Wash- ington County.				×	
* <i>Archimedes scallopanus</i> Hall, 8. Harrison County.				✓	
<i>Archimedes wortheni</i> Hall, 8. Harrison County, Orange County and Wash- ington County.				✓	
<i>Beatricea nodulata</i> Billings. Richmond (James).	×				
<i>Beatricea nodulosa</i> Bill. Connersville (James).	×				
<i>Buscopora dentata</i> Ulrich see <i>Buscopora lunata</i> , Rominger.					
<i>Buscopora lunata</i> Rominger (<i>Buscopora dentata</i>) Ulrich.			×		
Falls of the Ohio (Ulrich).					
<i>Callopora cercicornis</i> Hall, 11. Waldron.		×			
<i>Callopora ? diversa</i> Hall, 11. Waldron.		×			
<i>Callopora elegantula</i> Hall, 11. Osgood (Ulrich), Waldron.		×			

	Ordovician.	Silurian.	Devonian.	Carboniferous.	Quaternary.
	Cincinnati.	Clinton, Niagara and Water Limo.	Corriferous and Hamilton.	New Albany Shale, Knobstone and Rock- ford Limestone, Burlington and Keokuk, Warsaw and El- letts, Kankakee, Mansfield, Coal Measures, Drift.	
<i>Eoactinopora sexradiata</i> M. & W., S.					
Harrison County.					
<i>Fenestella (Unitrypa) acanthis</i> Hall.					
see <i>Uniteriypa acanthis</i> .					
<i>Fenestella (Unitrypa) acanthis</i> var. <i>inclinata</i> H.					
Falls of the Ohio.					
<i>Fenestella (Polypora) aculeata</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella (Polypora) adnata</i> Hall.					
see <i>Polypora adnata</i> .					
<i>Fenestella acmea</i> Hall, 11.					
Waldron (James Hall).					
<i>Fenestella ambigua</i> Hall, 11.					
see <i>Loculipora ambigua</i> .					
<i>Fenestella bellistriata</i> Hall, 11.					
Waldron.					
<i>Fenestella bifurca</i> Ulrich.					
Falls of the Ohio (A. E. Ulrich).					
<i>Fenestella bigeneris</i> Ulrich.					
Falls of the Ohio (A. E. Ulrich).					
<i>Fenestella bimbricata</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella biserrulata</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella (Polypora) celsipora</i> var. <i>minima</i> Hall.					
see <i>Polypora celsipora</i> var. <i>minima</i> .					
<i>Fenestella conferta</i> Hall, 11.					
Waldron.					
<i>Fenestella confertipora</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella (Hemitrypa) cribrifera</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella (Polypora) cultellata</i> Hall.					
see <i>Polypora cultellata</i> .					
<i>Fenestella cultrata</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella currijunctura</i> Hall.					
Falls of the Ohio (Hall).					
° <i>Fenestella delicata</i> Meek.					
Edwardsville.					
<i>Fenestella depressa</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella equalis</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella (Unitrypa) fastigata</i> Hall.					
see <i>Unitrypa fastigata</i> .					
<i>Fenestella hemitrypa</i> Prout.					
Spargen Hill (R. P. Whitfield).					
<i>Fenestella interrupta</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella (Polypora) laevistriata</i> Hall.					
see <i>Polypora laevistriata</i> .					
<i>Fenestella (Polypora) laevinodata</i> Hall.					
see <i>Polypora laevinodata</i> .					
<i>Fenestella latijunctura</i> Hall.					
Falls of the Ohio (Hall).					
<i>Fenestella lunulata</i> Hall.					
Falls of the Ohio (Hall).					
° <i>Fenestella parculipora</i> Hall, 11.					
Wabash County and Waldron (James Hall).					
<i>Fenestella patellifera</i> Ulrich.					
Falls of the Ohio (A. E. Ulrich).					
<i>Fenestella perplexa</i> Hall.					
Falls of the Ohio (Hall).					

	Cincinnati.	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Clinton.		Niagara and Water Line.	Corniferous and Hamilton.	New Albany Shale. Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Fenestella permarginata</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella pertenuis</i> Hall, II.						
— Falls of the Ohio.						
<i>Fenestella plumosa</i> Prout.						
— see <i>Hemityrypa plumosa</i> .						
<i>Fenestella (Unitrypa) projecta</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella proluxa</i> Hall, II.						
— Waldron.						
<i>Fenestella prisca</i> .						
— Madison.						
<i>Fenestella pulchella</i> Ulrich.						
— Falls of the Ohio (A. E. Ulrich).						
<i>Fenestella punctostriata</i> Hall, II.						
— Waldron (James Hall).						
<i>Fenestella (Polypora) quadrangularis</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella sculptilis</i> Ulrich.						
— Falls of the Ohio (A. E. Ulrich).						
<i>Fenestella semicircularis</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella serrata</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella shumardi</i> Prout, 8.						
— Harrison County.						
<i>Fenestella singularitas</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella stellata</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella (Unitrypa) stipata</i> Hall.						
— see <i>Unitrypa stipata</i> .						
<i>Fenestella (Polypora) striatopora</i> Hall.						
— see <i>Polypora striatopora</i> .						
<i>Fenestella (Polypora) submutans</i> Hall.						
— see <i>Polypora submutans</i> .						
<i>Fenestella tantulus</i> Hall, II.						
— Waldron (Jas. Hall).						
<i>Fenestella (Unitrypa) tegulata</i> Hall.						
— see <i>Unitrypa tegulata</i> .						
<i>Fenestella tenella</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella (Unitrypa) transversa</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella variopora</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fenestella verrucosa</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Fistulipora halli</i> Rominger.						
— Waldron (C. Rominger).						
<i>Fistulipora neglecta</i> Rominger.						
— see <i>Lichenalia concentrica</i> .						
<i>Fistulipora normalis</i> Ulrich.						
— Falls of the Ohio (Ulrich).						
<i>Fistulipora spargensis</i> Rominger.						
— Spargen Hill (Rominger).						
<i>Hiderella canadensis</i> Hall.						
— Falls of the Ohio (Hall).						
<i>Hemityrypa plumosa</i> Prout, 15.						
— (Fenestella plumosa) Washington County.						
<i>Idiotrypa parasitica</i> Ulrich.						
— Osgood (Ulrich).						
<i>Labechia montifera</i> Ulrich.						
— Madison (James).						

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Carboniferous and Hamilton. New Albany Shale	Knobstone and Rock- ford Limestone. Burlington and Cockuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures	Drift.
* <i>Lichenalia concentrica</i> Hall (<i>Fistulipora neglecta</i>) Waldron (Rominger).		x			
<i>Lichenalia concentrica</i> var. <i>maculata</i> Hall Waldron (James Hall).		x			
<i>Lichenalia concentrica</i> var. <i>parvula</i> Hall Waldron (James Hall).		x			
<i>Lichenotrypa cavernosa</i> Ulrich. Falls of the Ohio (Ulrich).			x		
<i>Lyrodietya romingeri</i> Hall. Crawfordsville.				x	
<i>Orthopora rhombifera</i> Hall. (<i>Trematopora orthopora rhombifera</i>). Falls of the Ohio.			x		
<i>Paleschara incrassata</i> Hall, 11. Waldron (James Hall).		x			
<i>Paleschara maculata</i> Hall, 11. Waldron and Wabash County (James Hall).		x			
<i>Paleschara offula</i> Hall, 11. Waldron (James Hall).		x			
<i>Paleschara</i> (?) (<i>Chetetes</i> ?) <i>sphaerium</i> Hall, 11. Waldron (James Hall).		x			
<i>Paleschara tuberculata</i> Prout. Spergen Hill (R. P. Whitfield).				x	
<i>Phractopora cristata</i> Hall. Falls of the Ohio (Hall).			x		
<i>Phractopora cristata</i> var. <i>lineata</i> Hall. Falls of the Ohio.			x		
<i>Phaenopora multifida</i> (Van Clee) Hall. Hanover (Foerste).	x				
<i>Phragmodietya catilliformis</i> Whitfield, 16 Crawfordsville.				x	
<i>Phragmodietya lineata</i> Hall, 16 Crawfordsville.				x	
<i>Phragmodietya patilliformis</i> , 16 Crawfordsville.				x	
<i>Physospongia dawsoni</i> Whitf. (<i>Uphantænia daw- soni</i>) Crawfordsville (Whitfield).				x	
<i>Pileotrypa ciliolata</i> Hall. Falls of the Ohio (Hall).			x		
<i>Pileotrypa denticulata</i> Hall. Falls of the Ohio.			x		
<i>Polypora adnata</i> Hall (<i>Fenestella</i> (<i>Polypora</i>) <i>adnata</i>). Falls of the Ohio.			x		
<i>Polypora blanda</i> Ulrich. Falls of the Ohio (Ulrich).			x		
<i>Polypora celipora</i> var. <i>minima</i> Hall. (<i>Fenestella</i> (<i>Polypora</i>) <i>celipora</i> var. <i>minima</i>). Falls of the Ohio (Hall).			x		
<i>Polypora cuneolata</i> Hall (<i>Fenestella</i> (<i>Polypora</i>) <i>cuneolata</i>). Falls of the Ohio (Ulrich).		x			
<i>Polypora halliana</i> Prout, 8. Harrison County.				x	
<i>Polypora laevistriata</i> Hall (<i>Fenestella</i> (<i>P.</i>) <i>lae- vistriata</i>). Falls of the Ohio (James Hall).		x			
<i>Polypora laevirodata</i> Hall (<i>Fenestella</i> (<i>Polypora</i>) <i>laevirodata</i>). Falls of the Ohio (Ulrich).		x			
* <i>Polypora strangula</i> White Dubois County.					x

	ORDOVICIAN	SILT- RIAN.	DEVON- IAN.	CARBONIFEROUS.				QUATERNARY.				
	Cincinnati.	Clinton.	Niagara and Water Lime.	Carboniferous and Hamilton.	New Albany Shale.	Knox and Rock- ford Limestone.	Burlington and Keokuk.	Warren and St. Louis.	Kaskaskia.	Manassas.	Coal Measures.	Drift.
<i>Trematella annulata</i> (<i>Trematopora</i> (<i>Trematella</i>) <i>annulata</i>)												
Falls of the Ohio (Hall)												
<i>Trematopora</i> (<i>Trematella</i>) <i>annulata</i> Hall												
see <i>Trematella annulata</i> .												
<i>Trematopora</i> (<i>Trematella</i>) <i>arbores</i> Hall												
Falls of the Ohio (Hall)												
<i>Trematopora</i> (<i>Chaetetes</i>) <i>erubripora</i> Hall, 11												
Waldron.												
<i>Trematopora echinata</i> Hall, 11												
Waldron (James Hall)												
<i>Trematopora spiculata</i> Hall, 11												
Waldron (James Hall)												
<i>Trematopora gravulifera</i> Hall, 11												
Waldron and Wabash County (James Hall)												
<i>Trematopora halli</i> Ulrich												
Waldron (Ulrich)												
<i>Trematopora hirsuta</i> Hall												
Clark County.												
<i>Trematopora infrequens</i> Hall, 11												
Waldron (James Hall)												
<i>Trematopora minuta</i> Hall, 11												
Waldron (James Hall)												
<i>Trematopora osculum</i> Hall, 11												
Waldron (James Hall)												
<i>Trematopora</i> (<i>Orthopora</i>) <i>regularis</i> Hall												
Falls of the Ohio (Hall)												
<i>Trematopora</i> (<i>Orthopora</i>) <i>rhombifera</i> Hall												
see <i>Orthopora rhombifera</i> .												
<i>Trematopora spiculata</i> Hall												
Waldron (James Hall)												
<i>Trematopora varia</i> Hall, 11												
Waldron and Wabash County (James Hall)												
<i>Trematopora</i> ? (<i>Trachypora</i> ?) <i>macropora</i> H., 11												
Waldron.												
<i>Trematopora variolata</i> Hall, 11												
Waldron (James Hall)												
<i>Trematopora whitfieldi</i> Ulrich												
Waldron (Ulrich)												
<i>Unytrypa acutis</i> (<i>Fenestella</i> (<i>Unytrypa</i>) <i>acutis</i>).												
Falls of the Ohio (Hall)												
<i>Unytrypa conferta</i> Ulrich												
Falls of the Ohio (A. E. Ulrich)												
<i>Unytrypa fastigata</i> Hall (<i>Fenestella</i> (<i>Unytrypa</i>) <i>fastigata</i>).												
Falls of the Ohio (Hall)												
<i>Unytrypa retroa</i> Ulrich												
Falls of the Ohio (A. E. Ulrich)												
<i>Unytrypa stipata</i> Hall (<i>Fenestella</i> (<i>U.</i>) <i>stipata</i>).												
Falls of the Ohio (Hall)												
<i>Unytrypa tegulata</i> Hall (<i>Fenestella</i> (<i>U.</i>) <i>tegulata</i>).												
Falls of the Ohio (Hall)												
<i>Uphantacina dawsoni</i> Whitf.												
see <i>Physiospongia dawsoni</i> .												
†BRACHIOPODA.												
<i>Ambocadia umbonata</i> Conrad, 11												
Shelby County.												
<i>Anastrophia internascens</i> Hall, 11												
Waldron (James Hall)												
<i>Anastrophia verneuili</i> Hall												
Waldron.												

†The author regrets that he has been unable to adopt in the present list the revised nomenclature of the *Brachiopoda* used by Mr. Schuchert in Bull. 87 U. S. G. S., owing to the appearance of that work after the present paper was in the hands of the printer.

	ORDOVICIAN	SILURIAN.	DEVONIAN.	CARBONIFEROUS.					QUATERNARY.			
	Cincinnati.	Clinton.	Niagara and Water Lime.	Oriskany and Hamilton.	New Albany Shale.	Knobstone and Rock- ford Limestone.	Byington and Keokuk.	Warsaw and St. Louis.	Waskaskia.	Manassas.	Coal Measures.	Drift.
<i>Athyris ambigua</i> Sowerby, 8 and 10. Orange County, Owen County, Putnam County, Montgomery County.												
<i>Athyris densa</i> H. & C. Washington County (Hall & Clark).												
* <i>Athyris hirsuta</i> Hall, 12. Greencastle, Washington County, Bloom- ington, Harrison and Monroe County.												
<i>Athyris incrassata</i> Hall, 8. Harrison County.												
* <i>Athyris lamellosa</i> L'Eveillé, 8. Harrison County, Washington County, Greencastle and Monroe County, Craw- fordsville (Hall & Clark).												
<i>Athyris planosulcata</i> Phillips, 8. Warren County.												
<i>Athyris roysii</i> Leveillé, 8. Harrison County, Crawfordsville and Or- ange County.												
* <i>Athyris subquadrata</i> Hall, 8. Harrison County.												
<i>Athyris spiriferoides</i> Eaton Utica, Clark County and Charlestown.			X	✓								
* <i>Athyris sublamellosa</i> Hall, 8. Greencastle, Harrison County, Reelsville and Putnam County.												
* <i>Athyris subtilita</i> Hall, 13. Vanderburgh County, Harrison County, Orange County, Owen County, Montgom- ery County, Clay County (C. A. White).												
* <i>Athyris trinuclea</i> Hall (<i>Terebratula trinuclea</i>), 12. Greencastle, Spergen Hill, Monroe County, Harrison County, Washington County, Bloomington (Hall).												
<i>Athyris vittata</i> Hall, 11. Falls of the Ohio, Charlestown Ldg. (Net- tleroth).				✓								
* <i>Atrypa aspera</i> Schlotheim. Falls of the Ohio, Charlestown, Clark County (Nettleroth).			X	✓								
<i>Atrypa cuspidata</i> see <i>Tripllesia cuspidata</i> .												
<i>Atrypa ellipsoides</i> Nettleroth. Falls of the Ohio (Nettleroth).				✓								
<i>Atrypa marginalis</i> Dalman. Hanover (Foerste).			X									
<i>Atrypa marginalis</i> var. <i>multi-striata</i> Foerste. Hanover (Foerste).			✓									
* <i>Atrypa reticularis</i> Linn., 11. Henry County, Utica, Clark County, Mad- ison, Falls of the Ohio, Wabash County, Charlestown, Carroll County, Waldron (Hall).			X	X								
<i>Atrypa latocorrigata</i> Foerste. Ripley County (Foerste).												
<i>Atrypa reticularis</i> var. <i>niagarensis</i> Nettleroth. Clark County (Nettleroth).			✓									
* <i>Camarophoria subtrigona</i> Meek & Worthen. Harrison County and Crawfordsville.												
<i>Camarospira eucharis</i> Hall. Case County (Hall & Clark).				X								
<i>Camarotoechia carolina</i> Hall. Falls of the Ohio (Hall & Clark).				✓								

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Coriuteros and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone, Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures. Drift.	
<i>Chonetes acutiradiatus</i> Hall.....			×		
Falls of the Ohio, Utica and Clark County (James Hall) (Nettleroth).					
<i>Chonetes coronata</i> Conr.....			×		
Scott County, New Albany (Borden).					
* <i>Chonetes fisheri</i> N. & P.....			×		
Montgomery County.					
* <i>Chonetes granuliferus</i> Owen, 8.....				×	×
Harrison County and Vigo County.					
* <i>Chonetes lepidus</i> Hall.....			×		
New Albany, Scott County, Lexington and Jennings County (Whitfield).					
<i>Chonetes logani</i> Norwood & Pratten, 8.....				×	×
Harrison County.					
<i>Chonetes mesolobus</i> N. & P.....					×
Clay County and Vanderburg County.					
* <i>Chonetes nana</i> de Verneuil.....			×		
Falls of the Ohio (Norwood & Pratten).					
* <i>Chonetes nota-scotia</i> Hall, 11.....		×			
Waldron (James Hall).					
* <i>Chonetes planumbonus</i> M. & W., 8.....				×	×
Clark County, Crawfordsville, Washington and Harrison Counties.					
<i>Chonetes subquadrata</i> Nettleroth.....			×		
Falls of the Ohio (Nettleroth).					
* <i>Chonetes undulatus</i> , Hall, 11.....		×			
Waldron (James Hall).					
* <i>Chonetes verneuiliatus</i> N. & P., 13.....					×
Every county in coal measures (C. A. White).					
* <i>Chonetes yansellianus</i> Hall, 11.....		×			
Falls of the Ohio, Utica and Clark County (Nettleroth).					
<i>Cleiothyris hirsuta</i> Hall.....				×	
Washington County (Hall & Clark).					
<i>Coelospira disparilis</i> Hall, 11.....		×			
Waldron (Hall).					
<i>Crania bordeni</i> Hall & Whitf.....		×			
Watson (Nettleroth).					
<i>Crania greenii</i> Miller, 18.....		×			
Falls of the Ohio.					
* <i>Crania lucia</i>	×				
Richmond and Versailles (M. & F.).					
<i>Crania modesta</i> White and St. John, 13.....					×
Vermillion and Sullivan Counties (C. A. White).					
<i>Crania reticularis</i> Miller.....					
Brookville (Miller).					
* <i>Crania setifero</i> Hall, 11.....		×			
Waldron (James Hall).					
<i>Crania siluriana</i> Hall, 11.....		×			
Waldron (James Hall).					
<i>Crania spinigera</i> Hall, 11.....		×			
Waldron.					
<i>Cryptonella leos</i> Hall.....			×		
Clark County.					
<i>Cryptonella ovalis</i> Miller, 17.....			×		
Bunker Hill.					
<i>Cyrtina crassa</i> Hall.....			×		
Falls of the Ohio, Utica (Nettleroth).					
* <i>Cyrtina hamiltonensis</i> Hall.....			×		
Clark County (Nettleroth).					
<i>Cyrtina hamiltoniae</i> var. <i>recta</i> Hall.....			×		
Falls of the Ohio (Nettleroth).					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Derbya crassa</i> Meek & Hayden (H. <i>crassus</i>), 8 and 13. Harrison County.					✓
<i>Derbya ruginosa</i> Hall & Clarke New Providence (Hall).					
<i>Delthyris acutilirata</i> Conr. see <i>Orthis acutilirata</i> .			×		
* <i>Discina ampla</i> Hall. Charlestown.			×		
* <i>Discina conreza</i> Shumard, 13. Dubois County.					×
<i>Discina doria</i> Hall Clark County (Nettleroth).			×		
* <i>Discina grandis</i> Hall Watson and Charlestown (Nettleroth).			×		
<i>Discina seneca</i> Hall Charlestown.			×		
* <i>Discina nitida</i> Phillips, 8. Harrison County? (Collett), (C. A. White).					×
<i>Eichwaldia reticulata</i> Hall, 11 Waldron (James Hall).		×			
<i>Eumetria verneuilliana</i> Hall (<i>Retsia verneuilliana</i>) 12. Harrison County, Bloomington and Spergen Hill (Hall), Greencastle.				×	
* <i>Eumetria vera</i> Hall, 8. Harrison, Montgomery and Orange Counties.				×	
<i>Hemipronites crassus</i> Meek & Hayden, 13. see <i>Derbya crassa</i> .					
<i>Hemipronites crenistriatum</i> Phillips see <i>Streptorhynchus crenistriatum</i> .					
<i>Hemipronites subenta</i> Conr. see <i>Streptorhynchus subentum</i> .					
<i>Hemipronites sulcata</i> de Verneuil see <i>Streptorhynchus sulcatum</i> .					
* <i>Leiorhynchus limitare</i> Vanuxem 6. Scott County.			×		
* <i>Leiorhynchus quadricostatum</i> Vanuxem, 8. Harrison County, New Albany, Jennings County, Scott County (Whitfield) (Nettle- roth).			×	×	
* <i>Leptaena scirra</i> Sowerby? (Foerste). Ripley County, Madison, Richmond, etc. (Cornett).	×	×			
<i>Leptaena transversalis</i> ? Wahlenberg, 6 Madison.	×				
<i>Leptaena transversalis</i> var. <i>elegantula</i> Foerste Hanover (Foerste).		×			
<i>Lingula crawfordavillensis</i> Gurley. Crawfordsville (Gurley).				✓	
<i>Lingula gibbosa</i> Hall, 11 Waldron.		×			
<i>Lingula indianensis</i> M. & G. Crawfordsville (Miller & Gurley).				✓	
* <i>Lingula spatulata</i> Vanuxem Jennings County and New Albany.			×		
<i>Lingula subpatulata</i> M. & W. Clark County.		×			
<i>Lingula triangulata</i> Nettleroth Falls of the Ohio (Nettleroth).			×		
<i>Lingula umbonata</i> Cox, 13 Vermillion County (C. A. White).					×
<i>Lingula carkhorni</i> Miller. Versailles and Ripley County (Miller).	×				

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.						QUATERNARY.		
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures.	Drift.
<i>Meekella striatocostata</i> Cox, 13.											×	
Vigo County.												
<i>Meristella harkinsi</i> Hall				×								
Charlestown.												
<i>Meristella uncuta</i> Hall				×								
Falls of the Ohio (Nettleroth).												
<i>Meristella rectirostrata</i> Hall, 11			×									
Waldron												
<i>Meristella umbonata</i> ? Billings		✓										
Hanover (Foerste).												
<i>Meristella unisulcata</i> Conrad.			×									
Utica, Clark County and Falls of the Ohio (Nettleroth).												
<i>Meristina maria</i> Hall, 11			×									
Waldron (James Hall) (Nettleroth).												
<i>Meristina nitida</i> Hall, 1			×									
Waldron and Wabash County (James Hall).												
<i>Nucleospira concinna</i> Hall.			×									
Utica, Clark County and Falls of the Ohio (Nettleroth).												
<i>Nucleospira indianensis</i> Miller, 17.				×								
Bunker Hill.												
<i>Nucleospira pisiformis</i> Hall, 11												
Waldron (James Hall).												
<i>Orthis (Platystrophia) acuticostata</i> Conr., 10												
Richmond, Madison, and Clarksville (Miller & White).												
<i>Orthis benedicti</i> Miller, 17.				×								
Wabash County and Hartsville).												
<i>Orthis bifurcata</i> Schlotheim.			×									
Hanover, Madison and Osgood (Foerste).												
<i>Orthis biloba</i> Linn., 11			×									
Wabash County.												
<i>Orthis borealis</i> Billings.			✓									
Madison.												
<i>Orthis calligramma</i> Dalman.												
Hanover (Foerste).												
<i>Orthis (Orthis) dinorthis calligramma</i> Dalman.				×								
Hanover (Foerste).												
<i>Orthis centrosta</i> Miller												
Madison.												
<i>Orthis dentata</i> Pander												
Madison and Ripley County.												
<i>Orthis dubia</i> Hall, 12.												
Harrison County, Spargen Hill, Bloomington, Greensburg, and Washington County (Hall)												
<i>Orthis ella</i> Hall.												
Madison.												
<i>Orthis elegantula</i> Dalman, 11.			✓									
Waldron (James Hall), Hanover (Foerste).												
Wabash County.												
<i>Orthis emacrerata</i> Hall												
Madison and Franklin County (Moore).												
<i>Orthis emacrerata</i> var. <i>multisepta</i> , 6.			✓									
Madison.												
<i>Orthis fasciata</i> Hall.			✓									
Madison and Lawrenceburg (Miller).				✓								
<i>Orthis goodrici</i> Nettleroth.												
Falls of the Ohio (Nettleroth).												
<i>Orthis hybrida</i> Sowerby, 11.			✓									
Waldron (James Hall).												
<i>Orthis insculpta</i> Hall, 6.			✓									
Madison, Franklin County (Moore).												

	ONDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.							
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Wrensen and St. Louis.	Kaskaskia.	Mississippi.	Coal Measures.	Drift.
<i>Pentamerus fornicatus</i> var., Hall, 11.		X										
Waldron.		X										
* <i>Pentamerus galeatus</i> Dalman.		X										
Huntington.		X		X								
* <i>Pentamerus knighti</i> Sowerby.		X										
Carroll County and Clark County. (Nettleroth).		X										
<i>Pentamerus l. quintus</i> Conr.		X										
Delhi (Conrad).		X										
<i>Pentamerus apicatus</i> Hall, 11.		X										
Charleston and Huntington.		X										
* <i>Pentamerus oblongus</i> Sowerby, 11.		X										
Huntington and Jefferson Counties and Delaware county.		X										
<i>Pentamerus occidentalis</i> Hall.		X										
Carroll County.		X										
* <i>Pentamerus cetriceus</i> Hall.		X										
Madison.		X										
<i>Pholidops calcicola</i> Hall & Clark, 11.		X										
Falls of the Ohio (Clark & Hall).		X										
<i>Pholidops ovalis</i> Hall, 11.		X										
Waldron (James Hall).		X										
<i>Productella semiglobosa</i> Nettleroth.				X								
Falls of the Ohio (Nettleroth).				X								
* <i>Productella spinulicosta</i> Hall (<i>Productus spinulicostus</i> a), 11.				X								
Charlestown and Shelby County.				X								
* <i>Productella subulata</i> Hall.				X								
Falls of the Ohio.				X								
<i>Productella subulata</i> Hall.				X								
Jeffersonville (Hall).				X								
<i>Productella subulata</i> var. <i>antarctica</i> H. & W.		X										
Utica, Clark County (Nettleroth).		X										
* <i>Productus squicostatus</i> Shumard.											X	
Jubois County.											X	
<i>Productus alternatus</i> Norwood & Pratt., 8.						X						
Harrison County and Crawfordsville.						X						
<i>Productus ultonensis</i> N. & P., 8.						X			X			
Harrison County.						X			X			
* <i>Productus biserialis</i> Hall, 12.						X						
Washington County, Bloomington and Tippecanoe County.						X						
<i>Productus buchianus</i> de Koninck.										X		
Posey County (Norwood & Pratt).										X		
<i>Productus burlingtonensis</i> M. & W.						X						
Harrison county.						X						
* <i>Productus cetriceus</i> Worthen.												
<i>Productus cora</i> d'Orbigny, 8.						X	X					
Owen County, Reelsville, Putnam County, Crawfordsville, Clay County, Orange County, Greencastle, Vanderburgh County, Montgomery County, Monroe County, Harrison County, Quincy, Jackson County.						X	X					
* <i>Productus cora</i> var. <i>mogoyoni</i> Marcon.												
Spergen Hill.												
* <i>Productus costatus</i> Sowerby, 13 and 10.											X	
Throughout the coal measures.											X	
<i>Productus fimbriatus</i> Sowerby.											X	
Posey County (Norwood & Pratt.)											X	
<i>Productus Flemingi</i> Sowerby.						X			X?			
Leavenworth (Norwood & Pratt.) and Harrison County.						X			X?			

	Cincinnati.	Clinton. Niagara and Water Lime.	SILU- RIAN.	DEVON- IAN.	CARBONIFEROUS.	QUATER- NARY.
<i>Productus indianensis</i> Hall, 12..... Spergen Hill (Hall), Tippecanoe County and Washington County.						
<i>Productus inflatus</i> McChesney..... <i>see P. semireticulatus.</i>						
* <i>Productus keokuk</i> Hall..... Putnam County.					X	
<i>Productus lonispinus</i> Sowerby, 13..... Throughout the coal measure region (C. A. White).						
* <i>Productus magnus</i> M. & W., 16..... Crawfordsville and Harrison County.					X	
<i>Productus marginicinctus</i> Prout..... Spe gen Hill.						
* <i>Productus mesiolis</i> Hall..... Crawfordsville.						
* <i>Productus nebrascensis</i> Owen, 13..... Fountain, Vermillion, Pike and Vigo Coun- ties (C. A. White).						
* <i>Productus oreatus</i> Hall..... New Providence (Hall & Clark), Greencastle and Washington County.						
* <i>Productus punctatus</i> Martin, 16 and 11..... Crawfordsville (Vermillion, Vigo and Sulli- van Counties, C. A. White), Montgomery, Clay County, Harrison County, Washing- ton County, Greencastle, Owen County, Vanderburgh County and Monroe County.					X	
<i>Productus reticulatus</i> Gabb..... Scott County (Borden)					X	
* <i>Productus semireticulatus</i> Martin, 13..... Spergen Hill (R. P. Whitfield), Clay County, Tippecanoe County, Jacksonville, Mont- gomery County, Crawfordsville, Reelsville, Putnam County, Harrison County, Orange County, Washington County, Throughout the coal measures (C. A. White).					X	
* <i>Productus setigerus</i> Hall..... Crawfordsville						
<i>Productus splendens</i> Nor. & P..... Posey County (Norwood & Pratt.)					X	
* <i>Productus tenuicostatus</i> Hall, 8..... Washington County, Greencastle and Har- ris n County.						
<i>Productus undiferous</i> de Kon..... Posey County (Norwood & Pratt.)					X	
<i>Productus vittatus</i> Hall, 8..... Spergen Hill (R. P. Whitfield), Harrison County, Crawfordsville.						
<i>Productus wabashensis</i> Nor. & P..... New Harmony (Norwood & Pratt.)					X	
* <i>Productus wortheni</i> Hall..... Putnam County.						
<i>Rensseleria ovoides</i> Eaton..... Madison (Cornett).				X		
* <i>Retzia ecar</i> Hall, 11..... Waldron (James Hall)		X				
<i>Retzia mormonii</i> Marcou, 13..... Widely distributed (C. A. White).						X
* <i>Retzia ecar</i> <i>see Eumetria vera.</i>						
* <i>Retzia verneuillana</i> Hall..... <i>see Eumetria verneuillana.</i>						

	ORDOVICIAN	SELT- BLK.	DEVON- IAN.	CARBONIFEROUS.	QUATER- NARY.
	Indiana.	Clinton, Niagara and Water Lime.	Corrilltown and Hamilton, New Albany Shale.	Kushnetown and Rock- ford Limestones, Burlington and Keokuk, Warsaw and Mt. Lons.	Kaskaskia, Mansfield, Coal Measures, Drift.
<i>Rhynchonella acians</i> var. <i>convexa</i> Foerste	✓				
Hanover (Foerste).					
* <i>Rhynchonella acians</i> Hall, 11.	✓				
Waldron (James Hall).					
* <i>Rhynchonella cepax</i> Conrad, 10	✓				
Ripley County, Madison, Boone County, Franklin County (Moore), Richmond and Madison (Meek).					
<i>Rhynchonella cordata</i> Hall	✓				
Falls of the Ohio.					
<i>Rhynchonella colletti</i> Miller, 19	✓				
Wabash County.					
<i>Rhynchonella cuneata</i> Sow., 11	✓				
Delaware County.					
* <i>Rhynchonella dentata</i> Hall, 10	✓				
Richmond, Madison (Meek).					
<i>Rhynchonella explanata</i> McChesney	✓				
New Harmony (McChesney).					
<i>Rhynchonella greeniana</i> Ulrich	✓				
New Albany (Ulrich).					
* <i>Rhynchonella gruenenori</i> Hall, 12	✓				
Spergen Hill, Bloomington (Hall), Wash- ington County, Harrison County, Lanesville.					
* <i>Rhynchonella indianensis</i> Hall, 11	✓				
Waldron (James Hall).					
<i>Rhynchonella kokomoensis</i> Miller, 18	✓				
Kokomo (Miller).					
<i>Rhynchonella lousiavillensis</i> Nettleroth	✓				
Falls of the Ohio (Nettleroth).					
* <i>Rhynchonella macro</i> Hall, 12	✓				
Washington County.					
* <i>Rhynchonella missouriensis</i> Shumard	✓				
Rockford (Meek and Worthen).					
* <i>Rhynchonella mutata</i> Hall, 12	✓				
Washington County, Harrison County, Mon- roe County, Montgomery County, Orange County and Greencastle.					
* <i>Rhynchonella neglecta</i> Hall, 11	✓				
Waldron (Hall), Madison.					
<i>Rhynchonella (Etonia) obsolens</i> Hall	✓				
Rockford (Hall).					
<i>Rhynchonella ontariensis</i> , 8.	✓				
see R. Utah.					
* <i>Rhynchonella ricinula</i> Hall, 12	✓				
Spergen Hill (Hall), Greencastle, Washing- ton Co., Harrison Co. and Monroe Co.					
* <i>Rhynchonella stricklandii</i> ? Sowerby, 11.	✓				
Waldron (James Hall) (Nettleroth).					
* <i>Rhynchonella subcuneata</i> Hall, 12	✓				
Spergen Hill and Bloomington (Hall), Mont- gomery County, Orange County, Owen County, Greencastle, Crawfordsville, Quincy, Putnam County, Harrison County and Monroe County.					
<i>Rhynchonella tenuicostata</i> Roemer, 10	✓				
Waldron (White).					
<i>Rhynchonella tenuistriata</i> Nettleroth.	✓				
(Nettleroth).					
<i>Rhynchonella tethys</i> Billings, 11	✓				
see <i>tenuistriata</i> tethys.					
* <i>Rhynchonella utah</i> Maroon (R. oregonensis), 13 and 8	✓				
Throughout the coal measures (C. A. White), Harrison County.					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	(Orontius and Hamilton). New Albany Shale.	Knobstone and Rock- ford Limestone, Burlington and Keokuk, Warsaw and St. Louis. Kaskaskia Mansfield. Coal Measures.	Drift
*Rhynchonella ventricosa Hall Madison.	x				
*Rhynchonella whitii Hall, 11. Walton (James Hall).		x			
Rhynchonella wartheni Hall, 15. Washington County				x	
*Rhynchonotreta cuneata var. americana Hall, 11. (Rhynchonella cuneata var. americana). (James Hall).		x			
*Schizocrania filosa Hall..... Madison.	x				
*Spirifer acuminata Conrad 10 Falls of the Ohio (Hall) Clark, Scott, Jeffers- son, Jennings and Jackson Counties (Kindle).			x		
*Spirifer angusta Hall, 11. Charlestown and Shelby County.			x		
*Spirifer arctisegmenta Hall..... Clark County. (Nettleroth).			x		
Spirifer aspera Hall, 8. Harrison County.				x	
Spirifer attenuatus Miller..... Falls of the Ohio (Nettleroth).			x		
Spirifer auritus..... Carroll County.					
Spirifer bicostatus? var. petila Hall, 11. Waldron.		x			
*Spirifer bifurcata Hall, 12. Spargen Hill (Hall), Washington County.				x	
*Spirifer biplicatus Hall..... Morgan County.				x	
Spirifer bynesi Nettleroth..... Clark County (Nettleroth).			x		
*Spirifer cameratus Morton, 13 and 16. Throughout the coal measures (C. A. White).					x
*Spirifer carteri Hall, 8. see Syringothyris carteri.				x x	
*Spirifer consobrina d'Orbigny..... Falls of the Ohio.			x		
*Spirifer crispus Hisinger, 11. Waldron (James Hall), Wabash County.		x			
Spirifer crispus var. simplex Hall, 11. Waldron (James Hall).		x			
Spirifer cuspidatus, 7. Owen County.				x	
Spirifer davisi Nettleroth..... Falls of the Ohio (Nettleroth).			x		
*Spirifer dearseni Hall..... Clark County and Bunker Hill (Nettleroth).			x		
Spirifer diademaria Hall..... Falls of the Ohio (Nettleroth).			x		
Spirifer eudora Hall, 11. Miami County, Waldron (James Hall).		x			
*Spirifer euruteines Owen, 11. Falls of the Ohio (Hall), Charlestown (Net- tleroth).			x		
Spirifer euruteines var. fornacula Hall..... Falls of the Ohio (Nettleroth).			x		
Spirifer fastigiatum M. & W., 16. see S. mortoniensis.					
Spirifer fimbriatus Conrad..... Clark County (Nettleroth).			x		
*Spirifer forbesi N. & P. Gosport.					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Carboniferous and Hamilton.	New Albany Shale. Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Manfield. Coal Measures.	Drift.
<i>Spirifer fultonensis</i> Worthen, 8.....				x	
Harrison county.					
<i>Spirifer glabra</i> Martin, 15.....		x	x	x	
Washington County.					
* <i>Spirifer gregaria</i> Clapp, 10.....					
Falls of the Ohio (Hall), Scott County, Clark County.					
<i>Spirifera priori</i> H. II.....			x		
Falls of the Ohio (Nettleroth).					
<i>Spirifer grimesi</i> Hall, 8.....				x	
Washington County and Harrison County.					
<i>Spirifer hobbsi</i> Nettleroth.....			x		
Falls of the Ohio (Nettleroth).					
<i>Spirifer incrasatus</i> ?.....				x	
Montgomery County.					
<i>Spirifer increbescens</i> Hall, 8.....				x	
Harrison County.					
<i>Spirifer kentuckensis</i> , 7.....				x	
Vanderburgh County and Owen County.					
* <i>Spirifer keokuk</i> Hall, 16.....				x x	
Greencastle, Crawfordsville, Washington County, Harrison County, Quincy, Putnam County, Owen County, Scott County (Bor- den).					
<i>Spirifer lateralis</i> Hall, 8.....				x	
Greencastle, Washington County and Har- rison County.					
<i>Spirifer ledayi</i> N. & P., 8.....				x	
Spergen Hill (R. P. Whitfield), Quincy, Put- nam County, Harrison County, Owen County and Orange County.					
* <i>Spirifer lineata</i> Martin, II and 13.....				x x x	x
Throughout the coal measures (C. A. White), Montgomery County and Orange County.					
* <i>Spirifer logani</i> H. II.....				x	
Crawfordsville.					
<i>Spirifer macconathi</i> Nettleroth.....		x			
Falls of the Ohio (Nettleroth).					
<i>Spirifer manni</i> Hall.....		x			
Clark County.					
<i>Spirifer marionensis</i> Schumard, 8.....		x		x	
Harrison County (Collett), Falls of the Ohio (Nettleroth).					
<i>Spirifer medialis</i> Hall.....		x			
Falls of the Ohio, Clark County (Nettleroth).					
* <i>Spirifer mortoni</i> Miller (Sp. fastigiatum).....				x	
Crawfordsville and Harrison County (Meek & Worthen).					
* <i>Spirifer mucronatus</i> Conrad?.....		x			
Clark County (Nettleroth).					
<i>Spirifer neglectus</i> Hall, 8.....				x	
Greencastle, Harrison County, Edwardsville, Owen County, Monroe County and Wash- ington County.					
<i>Spirifer nigrescens</i> Hall, II.....		x			
Delaware County.					
<i>Spirifer norcondiana</i> Hall, 15.....				x	
Spergen Hill (Hall), Washington County?					
* <i>Spirifer opimus</i> (Hall).....					x
see S. rockymontana. New Harmony (Mc Chesney).					
* <i>Spirifer oweni</i> Hall, II.....		x			
Falls of the Ohio (Hall) and Charlestown.					

	ORONOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corriferous and Hamilton. New Albany Hhale.	Knobstone and Rock- ford Limestone. Byrlington and Keokuk. Warren and Mt. Leadb.	Kaskaskia. Mansfield. Coal Measures. Drift.
<i>Spiriferina norwoodensis</i> Hall, 12. Spergen Hill.					
* <i>Spiriferina spinosa</i> Norwood and Pratton (<i>Spirifer spinosa</i>), 8. Bloomington (Hall), Spergen Hill (R. P. Whitfield), Harrison County.					
<i>Spirigera hirsuta</i> . see <i>Athyris hirsuta</i> .					
<i>Strophomena lethys</i> Billings Rhynchonella (lethys) Clark County and Falls of the Ohio.					
<i>Streptorhynchus chemungensis</i> var. <i>arctostriata</i> H. Falls of the Ohio (Nettleroth).					
<i>Streptorhynchus crenistriatus</i> Phillips, 8. Spergen Hill (R. P. Whitfield), Harrison County, Park County, Greencastle, Wash- ington County, Reelsville and Putnam County.					
<i>Streptorhynchus</i> (<i>Strophomena</i>) <i>elongatum</i> James. (James).	X				
<i>Streptorhynchus kokuk</i> Hall, 3. Scott County (Borden), Harrison County.					
* <i>Streptorhynchus nutans</i> Meek. Madison.	X				
<i>Streptorhynchus planumbonum</i> Hall (<i>Stropho- mena planumbonum</i>). Richmond (Meek), Madison (Hall).	X				
* <i>Streptorhynchus planicoarctum</i> Hall. S. E. Indiana	X				
<i>Streptorhynchus pectinaceum</i> H. New Albany (Hall).					
* <i>Streptorhynchus sublentum</i> Conrad (<i>Strophomena plicata</i>). Richmond and Madison.	X				
<i>Streptorhynchus subplanum</i> Conrad, 11. Waldron (James Hall).		X			
<i>Streptorhynchus tenue</i> Hall, 11. Waldron (James Hall).		X			
* <i>Streptorhynchus umbraculum</i> Von Buch., 12. New Providence.				X	
<i>Streptorhynchus</i> (<i>Strophomena</i>) <i>retortum</i> James. (James).	X				
<i>Strophodontia arcuata</i> Hall, 11. Shelby County.			X		
* <i>Strophodontia concava</i> Hall. Charlestown.			X		
<i>Strophodontia dewani</i> Conrad, 11. Charleston and Shelby County (Nettleroth).			X		
* <i>Strophodontia hemispheric</i> Hall. Falls of the Ohio (Hall), Clark County.		X	X		
* <i>Strophodontia inaequistriata</i> Conrad. Falls of the Ohio (Nettleroth).			X		
<i>Strophodontia naxea</i> Hall. Falls of the Ohio (Nettleroth).			X		
<i>Strophodontia perplanum</i> Conrad. Falls of the Ohio (Nettleroth).			X		
<i>Strophodontia plicata</i> Hall. Falls of the Ohio (Nettleroth).			X		
<i>Strophodontia profunda</i> Hall, 11 and 16. Waldron (James Hall), Allen County.		X			
* <i>Strophodontia semilaciniata</i> Hall. Waldron		X			
* <i>Strophodontia striata</i> Hall, 11. Waldron (James Hall).		X			

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Waraw and St. Louis. Kaskaskia. Manfield. Coal Measures	Drift.
<i>Strophomena alternata</i> Conrad, 10	x				
S. E. Indiana.					
<i>Strophomena alternata</i> var. <i>alternistriata</i> Hall	x				
Madison.					
<i>Strophomena flibusta</i>	x				
Madison.					
* <i>Strophomena fracta</i> Meek, 6.	x				
Madison.					
<i>Strophomena hamocrenensis</i> Foerste		x			
Hanover (Foerste).					
<i>Strophomena incurvata</i> (Shepard)	x				
Ripley County (Borden).					
* <i>Strophomena nasuta</i> Conrad.	x				
Madison.					
<i>Strophomena nutans</i>					
see Streptorhynchus nutans.					
<i>Strophomena patenta</i> Hall		x			
Hanover (Foerste).					
<i>Strophomena planoconvexa</i> Hall					
see Streptorhynchus planoconvexum.					
<i>Strophomena planumbona</i> Hall, 10					
see Streptorhynchus planumbonum.					
<i>Strophomena plicata</i>					
see Streptorhynchus subtentum.					
* <i>Strophomena rhomboidalis</i> Wilckens, 11	x	x	x	x	
Madison (Meek). Waldron (James Hall).					
Hartsville. Franklin County. Jasper County.					
Wabash County. Clark County (Nettle- roth).					
<i>Strophomena rugosa</i> Dalman, 6		x	x		
Madison.					
<i>Strophomena striata</i>					
see Strophodontia striata.					
<i>Strophomena sulcata</i> de Verneuil	x				
Richmond (Meek). Madison.					
* <i>Strophomena tenuistriata</i> Sowerby	x				
Richmond.					
<i>Strophomena tenuis</i> Hall		x			
Hanover (Foerste).					
<i>Strophonella semisacincta</i> Hall, 11.		x			
Waldron (James Hall).					
<i>Eggschekella hemiplicata</i> Hall, 13.					x
Coal Measures (C. A. White).					
<i>Syringothyris carteri</i> Hall, (?) 8				x	
Sp. carteri) Monroe, Harrison and Clark Counties.					
<i>Syringothyris texta</i> Hall, 8.					
Scott County (Borden). Borden and New Albany (Hall). Jackson County and Har- rison County					
* <i>Terebratula bovidens</i> Morton, 13.				x	x?
Widely distributed throughout the Coal Measures (C. A. White). Greencastle. Or- ange County. Montgomery County. Van- derburgh County. Harrison County. Parke County and Monroe County.					
<i>Terebratula calvini</i> Hall and Whitfield, 8			x		
Harrison County					
* <i>Terebratula formosa</i> Hall, 12.				x	
Spargen Hill and Bloomington (Hall). Green- castle. Harrison County. Washington Coun- ty. Monroe County.					
<i>Terebratula garhyi</i> Miller, 17.					
Edwardsville.					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corruterous and Hamilton New Albany Shale.	Knobs and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mnsfield Coal Measures.	Drift.
<i>Terebratula harmonia</i> H. Falls of the Ohio (Hall).			X		
* <i>Terebratula huxleyi</i> Sowerby, 8. Owen County, Greencastle and Harrison County				X X	
<i>Terebratula inornata</i> McChesney, 8. Harrison County.				X X	
* <i>Terebratula juvenis</i> Hall Falls of the Ohio (Nettleroth).			X		
* <i>Terebratula lincklaeni</i> Hall Falls of the Ohio (Nettleroth).			X		
<i>Terebratula romingeri</i> Hall Clark County (Nettleroth).			X		
<i>Terebratula succinea</i> Martin, 16. Crawfordsville.				X	
<i>Terebratula subcuneata</i> see <i>Athyria trinuclea</i> .					
<i>Terebratula subtilis</i> Hall see <i>Athyria subtilis</i> .					
<i>Terebratula trinuclea</i> Hall Spergen Hill (Hall). Washington County, Owen County and Greencastle.				X	
* <i>Terebratula turpida</i> Hall, 12. Bloomington and Spergen Hill (Hall). Wash- ington County, Greencastle, Harrison and Monroe Counties.				X	
<i>Trematospira hirsuta</i> Hall Union and Clark County and Falls of the Ohio.		X	X		
<i>Trematospira mathewsoni</i> McChesney Madison (McChesney).		X			
* <i>Trematospira nobilis</i> Hall Charlestown.			X		
<i>Triplexia cuspidata</i> Hall (<i>Atrypa cuspidata</i>), 6. Madison.	X				
<i>Triplexia intellus</i> Hall, 11. Waldron.		X			
* <i>Triplexia waldronensis</i> M. & D. Waldron.		X			
* <i>Tropidoleptus carinatus</i> Conrad. Scott County (Borden), Clark County (Net- tleroth).			X X		
* <i>Whitfieldia maria</i> Hall Waldron.		X			
* <i>Zygospira hendii</i> Billings Madison (W. S. T. Cornett), Madison (Meek)	X				
<i>Zygospira minima</i> Hall, 11. Waldron.		X			
* <i>Zygospira modesta</i> Say. Madison (W. S. T. Cornett), Richmond and Madison (Meek), Franklin County (Moore)	X				
* <i>Zygospira modesta</i> var. <i>cincinnatiensis</i> James Madison.	X				

MOLLUSCA.

LAMELLIBRANCHIATA.

<i>Actinopteria boydi</i> Conr. Falls of the Ohio (Nettleroth) (Hall).			X		
* <i>Allorisma cuneatum</i> Swallow Warren County.					X
* <i>Allorisma minutum</i> McChesney, 8. Harrison County.				X	

	ORDOVICIAN.		SILURIAN.		DEVONIAN.		CARBONIFEROUS.						QUATERNARY.
	Cincinnati.		Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Wrenshaw and St. Louis.	Kaskaskia.	Manfield.	Coal Measures.	
<i>Ariculopecton spinuliferous</i> Worthen												x	
Crawfordsville (A. H. Worthen).													
<i>Ariculopecton winchelli</i> Meek, 8.								x					
Harrison County.													
<i>Avicula corrugata</i> James													
see <i>Pterinea corrugata</i> .													
<i>Avicula demissa</i> .													
see <i>Pterinea demissa</i> .													
<i>Avicula insueta</i> .													
see <i>Pterinea insueta</i> .													
<i>Bygonychia tenuistriata</i> Ulrich	x												
Richmond (Ulrich).													
<i>Cardiamorpha missouriensis</i> Shumard, 7												x	
Vanderburg County.													
<i>Cardiamorpha radiata</i> M. & W.													
see <i>Cardiopsis radiata</i> .													
<i>Cardiamorpha subglobosa</i> Meek							x						
Washington County.													
<i>Cardiola radicans?</i>													
see <i>Panetia radicans</i> .													
<i>Cardiopsis radiata</i> Meek & Worthen (<i>Cardiamorpha radiata</i>)							x						
Rockford (Meek & Worthen).													
<i>Chaenomya rhomboidea?</i> M. & W., 7.									x				
Orange County.													
<i>Clidophorus fabula</i> Hall	x												
Versailles (Miller).													
<i>Olinopistha antiqua</i> Meek					x								
Clark County (Nettleroth).													
<i>Olinopistha radiata</i> Hall, 13.												x	
(C. A. White).													
<i>Olinopistha striata</i> Nettleroth.					x								
Clark County (Nettleroth).													
<i>Olinopistha submissa</i> (H. & W.) Hall					x								
Louisville, Ky. (James Hall), Clark County													
(Nettleroth).													
<i>Olinopistha exarata</i> Ulrich	x												
Richmond (Ulrich).													
<i>Conocardium attenuatum</i> Conrad			x										
Waldron.													
<i>Conocardium carinatum</i> Hall, 12.									x				
Bloomington, Spergen Hill, Harrison and													
Washington Counties.													
<i>Conocardium catenatum</i> Hall, 12.									x				
Spergen Hill (Hall), Washington County.													
<i>Conocardium constrictum</i> Hall, 8.									x				
Harrison County.													
<i>Conocardium cuneata</i> Hall, 12.									x				
Bloomington and Spergen Hill (Hall), Mon-													
roe and Washington Counties, Greencastle													
and Harrison County.													
<i>Conocardium cuneus</i> Contr.													
Pendleton.													
<i>Conocardium elrodi</i> Miller, 17.			x										
Hartsville.													
<i>Conocardium equilaterale</i> Hall, 12.									x				
Spergen Hill (Hall), Washington County.													
<i>Conocardium exiguum</i> Miller, 17.					x								
Bunker Hill.													
<i>Conocardium indianense</i> Miller, 17.							x						
Crawfordsville.													
<i>Conocardium meekianum</i> Hall, 12.									x				
Washington County.													

: Schoharie-grit (James Hall).

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Conocardium ohioense</i> Meek.....			X		
Falls of the Ohio (James Hall), Madison.			X		
<i>Conocardium parvulum</i> Miller, 17.....			X		
Bunker Hill.					
<i>Conocardium prattenianum</i> Hall, 12.....				X	
Washington County.					
* <i>Conocardium trigonale</i> Hall, 11.....			X		
Madison (Meek) Falls of the Ohio (Nettle- roth).					
<i>Crenipactes retiferus</i> Shumard (<i>Lima retifera</i>).....					X
Knox, Gibson and Posey Counties (C. A. White).					
<i>Cyclocarchea milleri</i> Meek.....	X				
Versailles (Ulrich).					
<i>Cypriocardia stellata nucleata</i> Hall, 12.....				X	
Spergen Hill (Hall), Harrison County and Washington County.				X	
<i>Cypriocardella oblonga</i> Hall, 12.....				X	
Spergen Hill and Bloomington (Hall), Wash- ington County.					
<i>Cypriocardella plicata</i>					
see <i>Goniophora plicata</i> .					
<i>Cypriocardella subelliptica</i> Hall, 12.....				X	
Washington County.					
<i>Cypriocardia indianensis</i>					
see <i>Cypriocardia indianensis</i> .					
<i>Cypriocardia subplana</i>					
see <i>Edmondia subplana</i> .					
<i>Cypriocardia undulata</i> Gurley.....					X
Vermillion County (Gurley).					
<i>Cypriocardia ventricosa</i> Hall.....				X	
Rockford (James Hall).					
<i>Cypriocardites hainesi</i> Miller.....	X				
Richmond (Miller).					
* <i>Cypriocardites steckianensis</i> M. & W. (?).....	X				
Richmond (Miller & Meek).					
<i>Cypriocardinia arata</i> Hall, 11.....		X			
Waldron (James Hall).					
<i>Cypriocardinia cataracta</i> Contr.....			X		
Falls of the Ohio (Nettleroth).					
<i>Cypriocardinia (?) cylindrica</i> H. & W.....			X		
Louville, Ky. (James Hall), Falls of the Ohio (Nettleroth).					
<i>Cypriocardinia indenta</i> (Con.) Hall.....			X		
Falls of the Ohio (James Hall).					
<i>Cypriocardinia indianensis</i> Hall (<i>Cypriocardia in- dianensis</i>), 12.....				X	
Spergen Hill (Hall).					
<i>Cypriocardissia induta</i> var. <i>subequivalvis</i> H. & W.....			X		
Falls of the Ohio (Nettleroth).					
<i>Cythere carbonaria</i> Hall.....				X	
Spergen Hill (Hall), Greencastle and Har- rison County.					
<i>Edmondia subplana</i> Hall (<i>Cypriocardia subplana</i>), 12.....				X	
Spergen Hill (Hall).					
<i>Entolium oviculatum</i> Swallow, 13.....					X
Fountain, Vermillion, Vigo Pike, Dubois, Perry and Spencer Counties (C. A. White).					
<i>Glyptodonta cancellata</i> Nettleroth.....			X		
Falls of the Ohio (Nettleroth).					
<i>Glyptodonta occidentale</i> Hall.....			X		
Falls of the Ohio (James Hall).					

	ORDOVICIAN.							QUATERNARY.
	Unclunati.	Clinton.	Niagara and Water Lime.	Orontion and Hamilton.	New Albany Shale.	Knox and Keokuk Limestone.	Burlington and Warsaw and St. Louis.	
<i>Goniophora plicata</i> Hall (<i>Cypriocardella plicata</i>), 12.							x	
Bloomington (Hall).								
<i>Goniophora speciosa</i> Hall, 11.			x					
Waldron.								
<i>Goniophora truncata</i> Hall				x				
Falls of the Ohio (Nettleroth).								
<i>Grammysia arcuata</i> (Con.) H.				x				
Falls of the Ohio (James Hall).								
<i>Grammysia gibbosa</i> H. & W.				x				
Falls of the Ohio (Nettleroth).								
<i>Grammysia rhomboidalis</i> M. & W.						x		
Washington County.								
<i>Grammysia ventricosa</i> Meek						x		
Washington County.								
<i>Ichthyrodonta decipiens</i>	x							
Richmond (Ulrich).								
<i>Ichthyrodonta elongata</i> Ulrich	x							
Richmond (Ulrich).								
<i>Ichthyrodonta miscneri</i> Ulrich	x							
Richmond (Ulrich).								
<i>Ichthyrodonta modioliformis</i> Ulrich	x							
Richmond (Ulrich).								
<i>Ichthyrodonta ovalis</i> Ulrich	x							
Richmond (Ulrich).								
<i>Leda bellistriata</i>								
see <i>Nuculana bellistriata</i> .								
<i>Leda nasuta</i> Hall, 12							x	
Spargen Hill and Lanesville.								
<i>Lima retifera</i> Shumard, 13								
see <i>Crenipecten retiferus</i> .								
<i>Limoptera cancellata</i> Hall				x				
Falls of the Ohio (James Hall).								
* <i>Lithophaga lingualis</i> Phillips, 16						x		
Lawfordsville and Harrison County.								
<i>Lithophaga pertenuis</i> M. & W.							x	
Lanesville.								
<i>Lunulicardium fragile</i> Hall					x			
Scott County (James Hall).								
<i>Macrondon obsoletus</i> Meek							x	
Spargen Hill (R. P. Whitfield).								
<i>Megapteria casei</i> M. & W., 10	x							
Richmond.								
<i>Megambonion lyon</i>	x					x		
Rockford (James Hall).								
<i>Modiolodon declivis</i> Ulrich	x							
Richmond (Ulrich).								
<i>Modiolodon sulcatus</i> Ulrich	x							
Richmond (Ulrich).								
<i>Modiolodon subovatus</i> Ulrich	x							
Versailles (Ulrich).								
<i>Modiolodon truncatus</i> Hall	x							
Versailles (Ulrich).								
* <i>Modiolopsis cincinnatiensis</i> H. & W.	x							
Richmond.								
<i>Modiolopsis concentrica</i> Hall & White	x							
(Ulrich).								
* <i>Modiolopsis modiolaris</i>	x							
Madison and Richmond.								
* <i>Modiolopsis perlata</i> Hall, 11		x						
Waldron (James Hall).								
* <i>Modiolopsis pholadiformis</i> Hall	x							
Richmond (Miller).								

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rockford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures. Drift.
<i>Modiolopsis subulata</i> Hall, 11 Waldron (James Hall).			x		
<i>Modiolopsis versuillensis</i> Miller Versailles (Miller).	x				
<i>Modiomorpha affinis</i> Hall. Clark County (James Hall).			x		
<i>Modiomorpha alta</i> Hall. Falls of the Ohio and Charlestown (James Hall).			x		
<i>Modiomorpha charlestownensis</i> Nettleroth. Clark County (Nettleroth).			x		
<i>Modiomorpha concentrica</i> Hall. Falls of the Ohio and Charlestown (James Hall).			x		
<i>Modiomorpha mytiloides</i> Conr. Clark County (Nettleroth).			x		
<i>Modiomorpha recta</i> Hall. Clark County (James Hall).			x		
<i>Monoteria longispina</i> Cox. Dubois County.					x
<i>Monoteria gibbosa</i> M. & W., 13. Vermillion, Sullivan and Posey Counties (C. A. White).					x
<i>Monotis (?) peregria</i> M. & W. Crawfordsville (Meek & Worthen).				x	
<i>Myalina concentrica</i> M. & W. Spargen Hill (Meek & Worthen).				x	
<i>Myalina keokuk</i> Worthen, 8. Harrison and Washington Counties and Crawfordsville.				x	
<i>Myalina subquadrata</i> Shumard, 13. Knox, Gibson and Posey Counties (C. A. White).					x
<i>Myalina smalli</i> McChesney, 13. Park, Vermillion and Vigo Counties (C. A. White), Dubois County.					x
<i>Mytilarca sigilla</i> Hall, 11. Waldron (James Hall).		x			
<i>Nucula hymn</i> Hall. Rockford (James Hall).			x		
<i>Nucula inflata</i> , 7. Vanderburgh County.					x
<i>Nucula lirata</i> Conrad, 11. Shelby County.			x		
<i>Nucula neta</i> H. & W. Louisville, Ky. (James Hall), Falls of the Ohio (Nettleroth).			x		
<i>Nucula notica</i> H. & W. Falls of the Ohio (James Hall) (Nettleroth).			x		
<i>Nucula herzeri</i> Nettleroth. Falls of the Ohio (Nettleroth).			x		
<i>Nucula nasuta</i> Hall. see <i>Nuculana nasuta</i> .					
<i>Nucula shumardiana</i> Hall, 15. Washington County.					
<i>Nucula ventricosa</i> Hall, 11. Sullivan County (C. A. White).					x
<i>Nuculana bellistriata</i> Stevens, 13. Vermillion, Sullivan, Vanderburgh and Warrick Counties (C. A. White).					x
<i>Nuculana nasuta</i> Hall (<i>Nucula nasuta</i>). Washington County (Hall).					
<i>Nuculana shumardiana</i> , 12. Spargen Hill (Hall).				x	

	ORDOVICIAN.		SILURIAN.		DEVONIAN.		CARBONIFEROUS.		TRIASSIC.		QUATERNARY.	
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knox and Knoxford Limestone.	Waverly and St. Louis.	Kaskaskia.	Massena.	Coal Measures.	Brick.	Drift.
<i>Opisthoptera casei</i> White.....	✓											
Richmond (Ulrich).												
<i>Opisthoptera obliqua</i> White.....	✓											
Richmond (Ulrich).												
<i>Orthodesma conspiciendum</i> Ulrich.....	✓											
Ulrich).												
* <i>Orthodesma parallelum</i> Hall.....	✓											
Madison.												
* <i>Orthodesma rectum</i> H. & W.....	✓											
Madison.												
<i>Orthodesma subangulatum</i>	✓											
Richmond (Ulrich).												
<i>Ortonella hainesi</i> Miller.....	✓											
Richmond (Ulrich).												
<i>Palaeoniscus bedfordensis</i> Meek.....						✓						
Washington County.												
<i>Paucicula radians</i> Conrad (<i>Cardiola radians</i>).....					✓							
Scott County (Whitfield).												
* <i>Paracyclus ellipticus</i> Hall, 10.....				✓								
Falls of the Ohio, and Clark County (James Hall).												
* <i>Paracyclus ellipticus</i> var. <i>occidentalis</i> Hall.....				✓								
Centerville.												
<i>Paracyclus elongata</i> Nettleroth.....				✓								
Clark County (Nettleroth).												
* <i>Paracyclus ovata</i> (Conr.) Hall.....				✓								
Falls of the Ohio and Clark County (James Hall).												
<i>Paracyclus octoloni</i> Nettleroth.....				✓								
Falls of the Ohio (Nettleroth).												
<i>Paracyclus ohioensis</i> Meek.....				✓								
Clark County (Nettleroth).												
<i>Pinna subpatulata</i> Worthen, 8.....						✓						
Washington and Harrison Counties.												
* <i>Pinna peracuta</i> Shumard, 13.....						✓						
Orange County (C. A. White).												
<i>Pterinea brisa</i> Hall, 11.....												
see <i>Pterinea striacosta</i> .												
<i>Pterinea corrugata</i> James (<i>Avicula corrugata</i>).....	✓											
Wayne County (James).												
* <i>Pterinea concentrica</i> Conr.....				✓								
Charlestown.												
* <i>Pterinea demissa</i> Conrad (<i>Avicula demissa</i>).....	✓											
Madison (W. S. T. Cornett).												
* <i>Pterinea flabellum</i> Conr., 11.....				✓								
Falls of the Ohio and Shelby County.												
<i>Pterinea grandis</i> Hall.....				✓								
Scott County (James Hall).												
<i>Pterinea insueta</i> Emmons (<i>Avicula insueta</i>).....	✓											
Madison (Cornett).												
<i>Pterinea striacosta</i> McChesney (<i>Pterinea striacosta</i>).....			✓									
Waldron (James Hall).												
<i>Pterinopecten nodosus</i> Hall.....				✓								
Falls of the Ohio (James Hall).												
<i>Pterinopecten reflexus</i> Hall.....				✓								
Falls of the Ohio (James Hall).												
<i>Pteronites spergensis</i> Whitfield.....						✓						
Spergen Hill and Bloomington (R. P. Whitfield).												
<i>Ptychodesma knappianum</i> H. & W.....					✓							
Falls of the Ohio (James Hall).												
<i>Rhytyma byrnesi</i> Miller.....	✓											
Richmond (Ulrich).												

	ORDOVICIAN.		SILURIAN.	DEVONIAN.	CARBONIFEROUS.					QUATERNARY.		
	Cincinnati.	Clinton	Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures.	Drift.
<i>Sanguinolites? multistriatus</i> Worthen Crawfordsville (A. H. Worthen).						x						
<i>Schizodus mediusensis</i> Meek Washington County.						x						
* <i>Solenomya mundotoides</i> Meek Dubois County.											x	
<i>Solenomya (Jonesi) vetusta</i> Meek Falls of the Ohio (James Hall).				x								
<i>Sphenolium richmondense</i> Miller Richmond (Miller & Faber).	x											
<i>Tellinomya cingulata</i> Ulrich Madison (Ulrich).	x											
<i>Tellinomya hilli</i> Miller Osgood (Miller).	x											
<i>Whitella obliquata</i> Ulrich (Ulrich).	x											
<i>Yoldia? oenai</i> McChesney New Harmony (McChesney). Rush Creek.											x	
<i>Yoldia rushensis</i> McChesney New Harmony (McChesney).											x	
<i>Yoldia? valentini</i> H. & W. Clark County (Nettleroth).				x								
SCAPHOPODA.												
<i>Dentalium aculeolatum</i> Gurley Newport and Vermillion County (Gurley).											x	
<i>Dentalium primum</i> Hall, 8. Greencastle, Montgomery County, Crawfordsville, Harrison County and Orange County.						x	x	x				
<i>Dentalium princeps</i> , 7 Owen County.						x						
<i>Dentalium ornatum</i> , M. & W., 8 Harrison County.								x				
GASTROPODA.												
* <i>Bellerophon bilobatus</i> Sowerby	x											
<i>Bellerophon cancellatus</i> Hall Bloomington and Spargen Hill (Hall).							x					
* <i>Bellerophon carbonarius</i> Cox, 13 Vanderburgh County, Sullivan County, Orange County and Vigo and Harrison Counties.											x	
<i>Bellerophon crassus</i> M. & W., 13. Sullivan and Posey Counties (C. A. White).											x	
<i>Bellerophon crenistria</i> Hall Clark County.				x								
* <i>Bellerophon cyrtolites</i> Hall Rockford (Hall); (Meek & Worthen).						x						
<i>Bellerophon exiguus</i> Foerste Hanover (Foerste).		x										
* <i>Bellerophon gibsoni</i> White, 11. Washington County, Greencastle and Orange County.							x					
<i>Bellerophon garbhi</i> Miller, 17 Dearborn County.	x											
<i>Bellerophon lida</i> H. H. Clark County (Nettleroth).				x								

	ONDOVICHIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.							QUATERNARY.	
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corriferous and Hamilton.	New Albany Shale.	Knobstone and Rockford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Coal Measures	Drift.
<i>Bellerophon levis</i> , 7.												
Orange County.												
<i>Bellerophon lineolatus</i> Hall.						✓						
Rockford (James Hall).												
<i>Bellerophon lyra</i> Hall.				✓								
Falls of the Ohio (Hall).												
<i>Bellerophon marcounus</i> (T) Geinetz, 8.								✓				
Harrison County.												
<i>Bellerophon mohri</i> Miller.	×											
Richmond (Ulrich).												
<i>Bellerophon montfortinus</i> N. & P., 7.											×	
Vanderburgh County.												
<i>Bellerophon nodocarinatus</i> Hall, 13.											×	
New Harmony and Sullivan County (C. A. White).												
<i>Bellerophon patulus</i> Hall, 11.				×								
Charlestown and Shelby County.												
<i>Bellerophon pelops</i> Hall.				×								
Charlestown.												
<i>Bellerophon pectariatus</i> Conrad, 13.											×	
Throughout the Coal Measures (White).												
<i>Bellerophon subangularis</i> Ulrich.	×											
Richmond (Ulrich).												
<i>Bellerophon subaenaris</i> Hall, 12.						✓		×				
Spergen Hill and Bloomington (Hall). Washington, Owen and Harrison Counties, Greencastle.												
<i>Bellerophon testilis</i> Hall, 12.								×				
Spergen Hill, Bloomington and Lanesville (H. H.).												
<i>Bellerophon tuber</i> Hall, 11.			×									
Waldron James Hall).												
<i>Bucania chionogensis</i> McChesney.			×									
Grant County.												
<i>Bucania deronici</i> H. & W.				×								
Clark Coun & Nettleroth).												
<i>Bucania crassa</i> Ulrich.	×											
Richmond (Ulrich).												
<i>Bucania cepatica</i> Hall.	×											
Richmond.												
<i>Bucania simulatrix</i> Ulrich.	×											
Richmond (Ulrich).												
<i>Bulimella bulimiformis</i> Hall.												
see <i>Bulimorpha bulimiformis</i> .												
<i>Bulimella canalliculata</i> Hall.												
see <i>Bulimorpha canalliculata</i> .												
<i>Bulimella elongata</i> Hall.												
see <i>Bulimorpha elongata</i> .												
<i>Bulimorpha bulimiformis</i> Hall, 12.								×				
Washington County.												
<i>Bulimorpha canalliculata</i> Hall, 12.								×				
Washington County.												
<i>Bulimorpha elongata</i> Hall, 1, 15.								×				
Washington County.												
<i>Callonema bellatula</i> Hall.				×								
Falls of the Ohio (Nettleroth).												
<i>Callonema irritator</i> H. & W.				×								
Clark County (Nettleroth).												
<i>Copulus acutirostris</i> .												
see <i>Platyceras acutirostrum</i> .												
<i>Copulus equilateralis</i> Hall.						✓						
Crawfordsville (Keyes).												
<i>Copulus infundibulum</i> Meek & W.						✓						
Crawfordsville (Keyes).												

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Connetquot and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestones— Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Manassas. Coal Measures.	Drift.
<i>Euomphalus planispira</i> Hall, 12.....					
Spergen Hill and Blooming on (Hall), Har- rison County, Monroe County, Green-castle and Washington County.				×	
<i>Euomphalus planorbiformis</i> Hall, 8.....				×	
Harrison County, Washington County and Orange County.				×	
<i>Euomphalus quadrivolvus</i> , 12.....					
see <i>St. aparollus quadrivolvus</i> .					
<i>Euomphalus rugosus</i> Hall, 13.....					
see <i>Euomphalus subrugosus</i> .					
° <i>Euomphalus sampsoni</i> Nettleroth.....			×		
Clark County (Nettleroth).					
<i>Euomphalus spergensis</i> , 12.....					
see <i>Straparollus spergensis</i> .					
<i>Euomphalus spergensis</i> var. <i>planorbiformis</i> , 12.....					
see <i>Straparollus spergensis</i> .					
<i>Euomphalus spirorbis</i>					
see <i>Straparollus spirorbis</i> .					
<i>Euomphalus subrugosus</i> M. & W. (E. <i>rugosus</i>).....					×
Throughout the Coal Measures (C. A. White).					
° <i>Euomphalus tioga</i> Hall.....			×		
Charlestown.					
<i>Helicotoma marginata</i> Ulrich.....	×				
Richmond (Ulrich).					
<i>Holopea grandis</i> Miller & Gurley.....				✓	
New Albany (Miller & Gurley).					
<i>Holopea hubbardi</i> Miller, 18.....	✓				
Madison.					
<i>Holopea prouti</i> a Hall, 12.....				×	
Spergen Hill (Hall), Washington County.					
° <i>Isanema liches</i> Hall.....			✓		
Charlestown.					
<i>Liospira vitruvia</i> Bill.....	×				
(Ulrich).					
<i>Lophospira acuminata</i> n. sp. or var. <i>p. angulata</i>	✓				
Richmond (Ulrich).					
<i>Lophospira umpla</i> Ulrich.....	✓				
Richmond (Ulrich).					
<i>Lophospira bowdensi</i> Safford.....	✓				
(Ulrich).					
<i>Lophospira multigrana</i> Miller.....	✓				
Madison and Richmond and Versailles.					
<i>Lozonema hamiltonae</i> Hall.....			✓		
Clark County (Nettleroth).					
<i>Lozonema hydraulicum</i> H. & W.....			×		
Charlestown (Nettleroth).					
<i>Lozonema laeviusculum</i> Hall.....			✓		
Falls of the Ohio (Nettleroth).					
<i>Lozonema nexile</i> Phillips, 11.....			✓		
St. elby County.					
<i>Lozonema rectistriatum</i> Hall.....			×		
Falls of the Ohio (Nettleroth).					
<i>Lozonema tersa</i> Hall.....			×		
Falls of the Ohio and Charlestown.					
<i>Lozonema vineta</i> Hall.....					
see <i>Murchisonia vineta</i> .					
<i>Lozonema vandellianum</i> Hall, 12.....				×	
Spergen Hill (Hall), Washington County.					
<i>Macrochelus fusiiformis</i>					
see <i>Soleniscus tusiformis</i> .					
<i>Macrochelus</i> (?) <i>littorarius</i> Hall, 12.....				×	
Bloomington.					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Uncinati.	Clinton. Niagara and Water Lime.	Coniferous and Hamilton.	New Albany Shale. Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warren and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
* <i>Pleurotomaria meekana</i> Hall, 12. Spergen Hill and Bloomington (Hall), Wash- ington County.				✓	
<i>Pleurotomaria mitigata</i> Hall Rockford (James Hall).				✓	
* <i>Pleurotomaria nodulostriata</i> Hall, 12 Spergen Hill and Bloomington (Hall), Wash- ington County.				×	
* <i>Pleurotomaria occidens</i> Hall Delphi.		×			
<i>Pleurotomaria pinsacensis</i> Hall, 15..... Washington County.				×	
<i>Pleurotomaria procteri</i> Nettleroth Clark County (Nettleroth).			×		
<i>Pleurotomaria rotundata</i> see <i>Pleurotomaria subglobosa</i> .					
* <i>Pleurotomaria shumardi</i> M. & W., 3. Harrison County and Crawfordville.				✓	
* <i>Pleurotomaria sphaerulata</i> Conrad, 13 Vanderburgh and Vigo (White).					×
<i>Pleurotomaria tabulata</i> Conrad., Hall (Hall).					×
<i>Pleurotomaria subangulatum</i> Hall see <i>Cyclonema subangulatum</i> Hall.					
<i>Pleurotomaria subglobosa</i> Hall, 12 (<i>Pleuroto- maria rotunda</i>) Spergen Hill and Bloomington.				✓	
* <i>Pleurotomaria subcompressa</i> Conrad Watson's Station and Falls of the Ohio (Hall)			×		
<i>Pleurotomaria subconica</i> , Hall Richmond.	×				
<i>Pleurotomaria scalloana</i> Hall, 12..... Spergen Hill and Bloomington (Hall), Wash- ington County.				✓	
* <i>Pleurotomaria tabulata</i> Conrad, 10 and 13. Rush Creek, Vigo County, and Posey County (White).					×
<i>Pleurotomaria textidigera</i> Meek..... Washington County.				✓	
<i>Pleurotomaria trilineata</i> Hall, 12 Spergen Hill (Hall), Washington County.				✓	
<i>Pleurotomaria trapidophora</i> Meek Versailles (Miller), Madison (W. S. T. Cor- nett).	✓				
<i>Pleurotomaria turbiniformis</i> M. & W., 13. Vigo County (C. A. White).					✓
<i>Pleurotomaria radosa</i> H. Rockford (James Hall).				✓	
* <i>Pleurotomaria wortheni</i> Hall, 12 Spergen Hill and Bloomington (Hall), Wash- ington County, Monroe and Harrison Counties.				✓	
<i>Polypheopsis fusiformis</i> Hall, 10..... Newport (C. A. White).					✓
<i>Polypheopsis lousicillae</i> H. & W. Falls of the Ohio (Nettleroth).			✓		
<i>Polypheopsis nitidula</i> M. & W., 1 Vermillion County (C. A. White).					×
<i>Protercarthia cancellata</i> Hall (Ulrich).	×				
<i>Protercarthia subcompressa</i> Ulrich Versailles (Ulrich).	×				
<i>Raphitoma richmondensis</i> Ulrich Richmond (Ulrich).	✓				

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Laine.	Corriferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Wray and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Conularia crawfordensis</i> R. Owen.					
<i>Conularia formosa</i> Miller & Dyer.					
<i>Conularia griffithi</i> M. & G.					
<i>Conularia infrequens</i> Hall, 11					
<i>Conularia intertexta</i> Miller, 15					
<i>Conularia microsema</i> Meek, 8					
<i>Conularia missouriensis</i> Swallow, 8 and 10.					
<i>Conularia niagarensis</i> Hall					
<i>Conularia newberryi</i> Winchell, 8.					
<i>Conularia quadrisulcata</i> (?) Miller.					
<i>Conularia subcarbonaria</i> Meek & Worthen, 8.					
<i>Conularia subulata</i> Hall, 12					
<i>Conularia spargensis</i> M. & G.					
<i>Hyalithes aculeatus</i> Hall (Puginculus aculeatus).					
<i>Hyalithes (?) dubius</i> M. & F.					
<i>Hyalithes reconditissimus</i> M. & F.					
<i>Hyalithes (?) (Thron) aculeatus</i> H.					
<i>Styliola fissurella</i> Hall (Tentaculites fissurella).					
<i>Tentaculites dextrihen</i> Hall.					
<i>Tentaculites fissurella</i> Hall					
<i>Tentaculites flexuosus</i>					
<i>Tentaculites richmondensis</i> Miller					
<i>Tentaculites sculariformis</i> Hall					
<i>Tentaculites tenuistriatus</i> M. & W.					
<i>Tentaculites niagarensis</i> Hall, 11					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warren and St. Louis. Kaskaskia. Manassas. Coal Measures.	Drift.
<i>Gyroceras abruptum</i> Hall, 11 Waldron.		x			
<i>Gyroceras baeri</i> M. & W. (<i>Trochoceras baeri</i>), Richmond (Miller) & (Meek).	x				
<i>Gyroceras elradi</i> White, 11 Hartsville, St. Paul and Delaware County.		x			
<i>Gyroceras gracile</i> Hall Rockford (J. Hall).				x	
<i>Gyroceras inelegans</i> Meek. Falls of the Ohio.			/		
<i>Gyroceras irinoianum</i> Conrad Logansport.			x		
<i>Gyroceras?</i> <i>rockfordensis</i> M. & W. Rockford (Meek & Worthen).				x	
<i>Heteromero-ceras cacabiformis</i> Newell, 17. Wabash County.		x			
<i>Heteromero-ceras delphicolium</i> Newell Delphi (Newell).		x			
<i>Kionoceras columnare</i> Hall (O. columnare) Wabash City (Newell).		x			
<i>Kionoceras striz</i> H. & W. (O. striz), 17 Wabash City (Newell), Delphi and Grant County.		x			
<i>Lituites bickmoreanus</i> Whitfield, 17 Wabash County.		x			
<i>Lituites grafftonensis</i> M. & W., 17 Wabash County.		x			
<i>Lituites marshi</i> Hall, 11 and 17. Wabash County, Delaware County.		x			
<i>Lituites multicostatus</i> Whitfield, 17. Wabash County.		x			
<i>Nautilus clarkianus</i> Hall. Spergen Hill (Hall), Washington and Tippe- canoe Counties.				x	
<i>Nautilus (Solenechilus) collectus</i> M. & W. see <i>Solenechilus collectum</i> .					
<i>Nautilus coxanus</i> , 12 see <i>Temnochilus coxanus</i> .				x	
<i>Nautilus decoratus</i> Cox. Vanderburgh, Clay and Vigo Counties and Greencastle.					
<i>Nautilus digonus</i> M. & W. see <i>Trematodiscus digonus</i> .					
<i>Nautilus forbesianus</i> McChesney, 13. Newport (C. A. White).					x
<i>Nautilus maximus</i> Conrad Falls of the Ohio (Nettleroth).					
<i>Nautilus missouriensis</i> Swall 7, 13 Fountain County (C. A. White).					x
<i>Nautilus occidentalis</i> Swallow. Dubois County.					x
<i>Nautilus oceanus</i> Hall, 11. Waldron.		x			
<i>Nautilus planorbiformis</i> M. & W. Dubois County.					x
<i>Nautilus (Cryptoceras) rockfordensis</i> M. & W. Rockford (Meek & Worthen).				x	
<i>Nautilus triullectus</i> M. & W. see <i>Trematodiscus triullectus</i> .					
<i>Nautilus (Discus) triullectus</i> M. & W. Rockford (Meek & Worthen).				x	
<i>Nautilus winslowi</i> M. & W., 13. see <i>Temnochilus winslowi</i> .					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton.	Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale. Knobstone and Rockford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures. Drift.	
<i>Orthoceras tenuifilum</i> Hall, 6 Madison (W. S. T. Cornett).	x				
<i>Orthoceras umyca</i> Hall Waldron.			x		
* <i>Orthoceras annulatum</i> Sowerby, 11 Newton County, Grant County, St. Paul and Hartsville.			x		
<i>Orthoceras bilineatum</i> , 6 Madison (W. S. T. Cornett).	x				
<i>Orthoceras culticollense</i> Miller & Gurley Clark County (Miller & Gurley).			x		
* <i>Orthoceras clavatum</i> Hall North Vernon.			x		
* <i>Orthoceras columnare</i> Hall, 17 see <i>Kionoceras columnare</i> .			x		
* <i>Orthoceras cyathense</i> Hall, 11 Wabash County, Grant County, Delaware County, Miami County and North Vernon.			x		
* <i>Orthoceras crebristriatum</i> M. & W. Waldron.			x		
<i>Orthoceras epigrus</i> Hall, 12 Spargen Hill (Hall), Lanesville.					
<i>Orthoceras repandum</i> Meek & Worthen, 8 Harrison County.					
<i>Orthoceras franklinense</i> Miller, 18 Franklin County.			x		
<i>Orthoceras garbyi</i> Miller 18 Franklin County.	x				
<i>Orthoceras</i> (ex <i>orthoceras</i> ?) <i>hanoverensis</i> Foerste. Hanover (Foerste).		x			
* <i>Orthoceras heterocinctum</i> Winch. Rockford.				x	
<i>Orthoceras icarus</i> Beecher. Rockford (J. Hall).				x	
<i>Orthoceras</i> (ex <i>orthoceras</i> ?) <i>ignotum</i> Foerste. Hanover (Foerste).		x			
* <i>Orthoceras imbricatum</i> Sowerby St. Paul.			x		
<i>Orthoceras indianense</i> Hall Rockford (J. Hall).				x	
<i>Orthoceras junceum</i> Hall Madison (W. S. T. Cornett).	x				
<i>Orthoceras longicameratum</i> Hall Waldron.			x		
<i>Orthoceras murellense</i> Vanuxem Rockford (J. Hall).				x	
<i>Orthoceras mutulare</i> Hall, 11 Waldron.			x		
<i>Orthoceras mabri</i> Miller Versailles (Miller).	x				
<i>Orthoceras obstructum</i> Newell, 17 Wabash County (Newell).			x		
<i>Orthoceras rigidum</i> Hall, 17 Peru (Newell), Wabash County.			x		
* <i>Orthoceras rubescens</i> McChesney, 13 Eugene, Newport, Lodi, Merom, Graysville, No Harmony, Newberg and Vanderburgh County.				x	
* <i>Orthoceras simulator</i> Hall, 11 Waldron (J. Hall), Newton County and Carroll County.			x		
<i>Orthoceras spinale</i> Madison (W. S. T. Cornett).	x				

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Clinton.	Niagara and Water Lime.	Carboniferous and Hamilton.	New Albany Shale. Knobstone and Rockford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
* <i>Orthoceras subancellatum</i> Hall, 11 St. Paul and Waldron.		x			
" <i>Orthoceras subulatum</i> Hall. Waldron.		x			
* <i>Orthoceras striz</i> Hall, 17. see Kinocerases striz.					
<i>Orthoceras unionense</i> Worthen, 17. Wabash County (Newell).		x			
" <i>Orthoceras schilti</i> Winch. Rockford.				x	
<i>Orthoceras winchelli</i> M. & W. Greencastle.					
<i>Orthoceras</i> (<i>Actinoceras</i>) <i>yongii</i> Foerste Hanover (Foerste).	x				
<i>Pentameroceras micrum</i> Barrande Delphi (Newell).		x			
<i>Phragmoceras angustum</i> Newell, 17. Wabash County.		x			
* <i>Phragmoceras ellipticum</i> H. & W. Clark County, Grant County and Wabash County.		x			
* <i>Phragmoceras linearis</i> New. Wabash County.		/			
" <i>Phragmoceer. nestor</i> Hall, 17. Grant County, Marion and Monon.		/			
* <i>Phragmoceras parvu</i> H. & W. Grant County.		x			
<i>Phragmoceras projectum</i> Newell, 17. Wabash County.		x			
<i>Phragmoceras walshi?</i> M. & W. Jeffersonville.			x		
<i>Remeleceras clarkense</i> Miller & Gurley Sampson Springs, Clark County (Miller & Gurley).				x	
<i>Soleniscus rockfordense</i> Miller, 17. Rockford.				x	
<i>Solenochilus henryvillensis</i> M. & G. Henryville (Miller & Gurley).				x	
<i>Solenochilus rockfordense</i> Miller Rockford (Miller).				x	
<i>Streptodiscus indianensis</i> Miller, 18. West Point.					x
" <i>Tenniocheilus coxarum</i> Meek & Worthen, 8. Orange County and Greencastle.					x
<i>Tenniocheilus niotense</i> M. & W., 8. Harrison County.				x	
" <i>Tenniocheilus winslowi</i> M. & W. (<i>Nautilus winslowi</i>) Danville and Dubois Counties (C. A. White).					x
<i>Trematodiscus digonus</i> M. & W. (<i>Nautilus digonus</i>) Jackson County.				x	
<i>Trematodiscus trisulcatus</i> M. & W. (<i>Nautilus trisulcatus</i>) Rockford (Meek & Worthen).				x	
<i>Trochoceras desplayianne</i> McChesney, 17. Wabash County.	x				
<i>Trochoceras</i> (?) <i>bueri</i> M. & W. see Gyrocera baeri.	x				
* <i>Trochoceras waldroni</i> n. sp. Waldron (Hall).	x				

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
ARTHROPODA.					
CLASS CRUSTACEA.					
PALEOSTRACA.					
<i>Acidaspis fimbriata</i> Hall, 11. Waldron.		X			
<i>Asaphus gigas</i> De Kay, 6. (<i>Isotelus gigas</i>) Madison (Cornett). Ripley County.	X				
<i>Asaphus megistus</i> Locke, 7. Ripley County.	X				
* <i>Calymene blumenbachii</i> see <i>Calymene niagarensis</i> .					
<i>Calymene nanus</i> Ulrich. Osgood. Ripley County (Miller).		X			
* <i>Calymene niagarensis</i> Hall, 11 (<i>C. blumenbachii</i>) Waldron (Hall), Wabash County, Jefferson County, Fayette County, Ripley County, Miami County and Madison.	X	/			
<i>Calymene callicephala</i> Green (<i>C. senaria</i>) Richmond (Meek), Franklin County.	X				
<i>Calymene platys</i> Green Falls of the Ohio (Hall & Clarke).			X		
<i>Calymene senaria</i> Conrad, 10. see <i>C. callicephala</i> .					
<i>Ceraurus scarius</i> Billings. Richmond (Meek).	X				
* <i>Ceraurus</i> (<i>Chelurus</i>) <i>niagarensis</i> Hall, 11. Waldron and Marion County (Hall).		X			
* <i>Cyphaspis christyi</i> Hall, 11. Waldron.		X			
<i>Carcinonema ingens</i> Clappole Kokomo (Clappole).		/			
<i>Carcinonema neelini</i> Clappole. Kokomo (Clappole).		X			
<i>Dalmanites calypso</i> Hall. see <i>Dalmanites caly</i> , so.					
<i>Dalmanites pleione</i> see <i>Dalmanites pleione</i> .					
<i>Dalmanites limulurus</i> see <i>Dalmanites limulurus</i> .					
<i>Dalmanites inchoatus</i> var. <i>subrinus</i> H. & C. Falls of the Ohio (Hall & Clarke).			X		
<i>Dalmanites</i> (<i>Coronura</i>) <i>aspectans</i> Conrad. Falls of the Ohio (Hall & Clarke).			X		
<i>Dalmanites corni</i> Hall, 11. Waldron (James Hall).		X			
<i>Dalmanites carleyi</i> Meek, 6. Madison (Cornett).		X			
<i>Dalmanites</i> (<i>Chasmops</i>) <i>calypso</i> Hall. Falls of the Ohio (Hall & Clarke).					
* <i>Dalmanites limulurus</i> Green (<i>Dalmanites limu- lorus</i>) Madison and Jefferson Counties (Cornett).					
* <i>Dalmanites micurus</i> Green. Louisville, Ky.		/			
* <i>Dalmanites ohioensis</i> Meek & Worthen. Madison and Falls of the Ohio.					
<i>Dalmanites</i> (<i>Cyphurus</i>) <i>pleione</i> Hall (<i>Dalmanites pleione</i>). Falls of the Ohio and Jennings County (Hall & Clarke).					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.						QUATERNARY.	
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton.	New Albany Shale.	Knobstone and Rock- ford Limestone.	Burlington and Keokuk.	Warsaw and St. Louis.	Kaskaskia.	Mansfield.	Goal Measures.	Drift.
* <i>Dalmanites pleuropteryx</i> Green Louisville, Ky.		X									
* <i>Dalmanites verrucosus</i> Hall, 11. Waldron (James Hall).		X									
* <i>Dalmanites vigilans</i> Hall, 11. Waldron (James Hall).		X									
<i>Encrinurus punctatus</i> Wahlenberg. Hanover (Foerste).		X									
<i>Euproops colletti</i> White, 13. Vigo County (White).										X	
<i>Eurypterus kokomoensis</i> Miller & Gurley Kokomo (Miller & Gurley).		X									
<i>Eurypterus lacustris</i> Claypole. Kokomo (Claypole).		X									
* <i>Homalonotus delphinocephalus</i> Green 11. Waldron (James Hall).		X									
<i>Illæus ambiguus</i> Foerste. Hanover (Foerste).		X									
* <i>Illæus armatus</i> Hall, 11. Waldron (James Hall).		X									
<i>Illæus daytonensis</i> H. & W. Osgood (Foerste).		X									
<i>Illæus insignis</i> Hall, 6. Madison.		X									
<i>Illæus madisonensis</i> Foerste. Osgood (Foerste).		X									
* <i>Illæus ioxus</i> Hall, 11. Renessalear & Waldron.		X									
* <i>Isotelus gigas</i> see <i>Asephas gigas</i> . Richmond.											
<i>Lichas boltoni</i> var. <i>occidentalis</i> Hall, 11. Waldron (James Hall).		X									
* <i>Lichas breviceps</i> Hall, 11. Waldron & Charlestown (James Hall), Han- over (Foerste).		X	X								
<i>Lichas byrneanus</i> M. & G. Madison (Miller & Gurley).		X									
<i>Lichas emarginatus</i> Hall. Waldron (James Hall).		X									
<i>Lichas hanoverensis</i> M. & G. Hanover (Miller & Gurley).		X									
* <i>Phacops bufo</i> Green. Charlestown, N. Vernon and Falls of the Ohio (Miller & Gurley).			X								
<i>Phacops cristata</i> var. <i>pipa</i> H. & C. Falls of the Ohio (Hall & Clarke).			X								
<i>Phacops gallicephalus</i> , 6. Madison (Cornett).											
* <i>Phillipsia bufo</i> M. & W., 10. Spergen Hill (Whitfield), Crawfordsville, Jacksonville and Harrison County.											
<i>Phillipsia doris</i> (Hall), Winch. (<i>Proteus doris</i>) Rockford (Herrick).					X						
* <i>Phillipsia meramecensis</i> Shumard. Lanesville and Bloomington.											
* <i>Phillipsia portlocki</i> M. & W. Harrison County and Washington.											
<i>Phillipsia rockfordensis</i> Winch. Rockford (Herrick).					X						
<i>Phillipsia (Griffithides) sangamonensis</i> M. & W. Perrysville, Eugene, Lodi, Silverwood, New- port and Dubois County (C. A. White)										X	

[illegible]

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Coniferous and Hamilton.	New Albany Shale. Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warren and St. Louis. Kaskaskia. Mansfield. Coal Measures	Drift.
<i>Orthopleurodus carbonarius</i> New. & W.					×
Posey County (St. John & Worthen).					
<i>Petalodus knappi</i> Newberry				×	
Harrison County (Newberry).					
<i>Peripristia semicircularis</i> N. & W. (Ctenopterygius semicircularis)					×
Posey County (Newberry & Worthen).					
<i>Petrodus occidentalis</i> (Newberry & Worthen), ? ..					×
Vigo County, Clay County, Vanderburgh County, Owen County.					
<i>Sandalodus minor</i> New. & Worthen (<i>Trigonodus</i> minor)				×	
Harrison County (Newberry).					
<i>Taeniodus regularis</i> St. John & Worthen				×	
Bedford (St. John & Worthen).					
<i>Thrinacodus bicornis</i> Newberry				×	
Harrison County (Newberry).					
<i>Trigonodus minor</i> N. & W.					
see <i>Sandalodus minor</i> .					
<i>Polyrhizodus tittoni</i> N. & W.				×	
Greencastle (Newberry).					
<i>Psammodus glyptus</i> St. J. & W.				×	
Greencastle (Newberry).					
MAMMALIA.					
<i>Canis dolichopais</i> Cope, 15					×
Harrison County.					
<i>Canis dolichopais ohioensis</i> Foster, 15					×
Richmond, Hancock County, near Green- field, Randolph County (J. Moore), Van- derburgh, Carroll and Kosciusko Counties.					
<i>Cervus virginianus</i>					×
Wabash County.					
<i>Dicotyles variegatus</i> Leidy, 15					×
Gibson County.					
<i>Dicotyles torquatus</i> , 15					×
<i>Elephas americanus</i> Blum, 15					×
Vigo, Parke, Vermillion, Wayne, Putnam, Vanderburgh and Montgomery Counties.					
<i>Elephas primigenius</i> , 15					×
Clinton and Wabash Counties.					
<i>Equus fraternus</i> Leidy, 15					×
<i>Equus major</i> DeKay, 15					×
<i>Mastodon americanus</i> Blum., 15					×
Covington, Fountain County, and Wabash County.					
<i>Megalonyx jeffersoni</i> Cuv., 15					×
Henderson, Ky.					
<i>Platygonus compressus</i> Le Conte, 15					×
Laketon, Wabash County.					
<i>Tapirus terrestris</i> ? 15					×
Evansville.					
PLANTAE.					
<i>Althopteris grandiflora</i> Newberry, 7					×
Vigo County.					
<i>Althopteris niagarensis</i> , 7					×
Vigo County.					

	ORDOVICIAN	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	trifurcatus and Hamilton New Albany Shale.	Knobstone and Rock- ford Limestone, Burlington and Kookuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures.	Drift.
<i>Annularia longifolia</i> Brongniart, 10.....					
Vigo County, Shelburn.					
<i>Annularia sphenophylloides</i> Zuker, 7.....					
Vigo County.					
<i>Asterophycus costii</i> Lesquereux, 13.....					
New Harmony.					
<i>Asterophyllites equisetiformis</i> Scholt.....					
Clay County.					
<i>Buthotrephis graciles</i> var. <i>crassa</i> Hall, 11.....		X			
Waldron (J. Hall).					
<i>Calamites canuiformis</i> Schlotheim, 8.....					
Harrison County.					
<i>Callipteridium sullivanti</i> Lesq. (<i>Callipteris sulli-</i> <i>vanti</i>), 10.....					
Spring Creek and Perrysville.					
<i>Callipteris sullivanti</i>					
see <i>Callipteridium sullivanti</i> .					
<i>Carpolithes fasciculatus</i> Lesqx., 8.....					
Harrison County.					
<i>Caulerpites marginatus</i> Lesquereux? 8.....					
Harrison County.					
<i>Chondrites colletti</i> Lesquereux, 8.....					
see <i>Taonurus colletti</i> .					
<i>Cordaites angustifolius</i> Lesquereux, 8.....					
see <i>Cordaites diversifolius</i> .					
<i>Cordaites borassifolia</i> Sternb., 8.....					
Harrison County, Montgomery County, Vigo County and Clay County.					
<i>Cordaites diversifolius</i> Lesq. (<i>C. angustifolius</i>).....					
Clay County, Vigo County and Harrison County.					
<i>Cyclopteris elegans</i> Lesq., 7.....					
Vigo County.					
<i>Hymenophyllites alata</i>					
see <i>Sphenopteris alata</i> .					
<i>Hymenophyllites primatiformis</i> Lesq., 7.....					
Vigo County.					
<i>Lepidodendron aculeatum</i> Sternberg.....					
<i>Lepidodendron dichotomum</i> Sternberg.....					
Orange County (Lesquereux).					
<i>Lepidodendron diplontegindes</i> Lesq.....					
<i>Lepidodendron elegans</i> Sternberg, 7.....					
Vigo County.					
<i>Lepidodendron forlatum</i> Lesq.....					
<i>Lepidodendron obovatum</i> Sternberg.....					
Orange County.					
<i>Lepidodendron rushvillense</i>					
Orange County (Lesquereux).					
<i>Lepidodendron reithimianum</i> Sternberg.....					
Orange County (David White).					
<i>Lepidophlois macrolepidotus</i> Goldf., 13.....					
Orange County (Lesquereux) Grape Creek.					
<i>Lepidophyllum brevifolium</i> Lesqx., 8.....					
Harrison County.					
<i>Lepidophyllum imbricata</i> Sternberg? 8.....					
Harrison County.					
<i>Lycopodites strictus</i> Lesqx.....					
New Harmony (Lesquereux).					
<i>Neuropteris bifurcata</i> Lesqx.....					
French Lick (David White).					

	ORDOVICIAN.	SILURIAN.	DEVONIAN.	CARBONIFEROUS.	QUATERNARY.
	Cincinnati.	Clinton. Niagara and Water Lime.	Corniferous and Hamilton. New Albany Shale.	Knobstone and Rock- ford Limestone. Burlington and Keokuk. Warsaw and St. Louis. Kaskaskia. Mansfield. Coal Measures. Drift.	
<i>Neuropteris collinae</i> Lesq.					x
Vigo County.					
<i>Neuropteris claudi</i> Lesq.					x
Orange County (Lesquereux).					
<i>Neuropteris hirsuta</i> Lesq.					x
Shelburn, Sullivan County, Spring Creek, Vermillion County (C. A. White), Vigo County and Clay County.					
<i>Neuropteris loshi</i> Brong., 7.					x
Vigo County.					
<i>Neuropteris rufinervis</i> Bunbury, 10 Clay County and Vigo County (C. A. White.)					x
<i>Neuropteris smithii</i> Lesq. ? Orange County (David White).					x
<i>Odontopteris subcaucata</i> Bunbury, 10 Vermillion County (C. A. White), Spring Creek.					x
<i>Paleophyculus diraricatum</i> Lesq., 13 Salt Creek, Vigo County (Lesquereux).					x
<i>Paleophyculus arceile</i> Lesq., 13 Salt Creek, Vigo County (Lesquereux).					x
<i>Paleophyculus lineare</i> Duden New Albany.			x		
<i>Paleophyculus milleri</i> Lesq., 13 Salt Creek, Vigo County (Lesquereux).					x
<i>Paleophyculus new-albani</i> Duden New Albany (Duden).			x		
<i>Paleozygis corrugatum</i> see <i>Spirangium corrugatum</i> .					
<i>Paleozygis prendelli</i> see <i>Spirangium prendelli</i> .					
<i>Parachyophyculus asphalticum</i> Duden New Albany (Duden).			x		
<i>Pecopteris callosa</i> see <i>Pseudopecopteris callosa</i> .					
<i>Pecopteris archiacensis</i> Scholtheim Vigo County.					x
<i>Pseudopecopteris callosa</i> Lesq. (<i>Pecopteris</i> <i>callosa</i>) Vigo County.					x
<i>Pseudopecopteris latifolia</i> Brongn. (<i>Sphenopteris</i> <i>latifolia</i>) Orange County (Lesquereux).					x
<i>Pseudopecopteris muricata</i> Brongn., 13 and 20 Orange County (Lesquereux) and (David White).					x
<i>Rhacophyllum abellatum</i> Sternb., 13 (Lesquereux).					x
<i>Sigillaria menardi</i> Brongniart, 7 Vigo County.					x
<i>Sigillaria oborata</i> Lesq., 7 Vigo County.					x
<i>Sigillaria oculata</i> Scholtheim, 7 Vigo County.					x
<i>Sigillaria reniformis</i> Brongn., 8 Harrison County.					x
<i>Sphenophyllum emarginatum</i> Brongn., 11 Warren County.					x
<i>Sphenophyllum schlotheimii</i> Brongn., 11 Vigo and Clay Counties.					x
<i>Sphenopteris alata</i> Brongniart (<i>Hymenophyllites</i> <i>alata</i>) Vigo County.					x

PART II. BIBLIOGRAPHY OF INDIANA PALEONTOLOGY.

1889. BEECHER, E. C., AND CLARK, JOHN M. The development of some Silurian Brachiopoda. Mem. N. Y. State Mus., Vol. 1, No. 1, pp. 1-95, pls. I-VIII, Oct., 1889. The material described is from the Niagara group at Waldron.
1888. BEECHLER, CHAS. Corrected list of fossils found at Crawfordsville, Indiana. 16th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., 1888, pp. 65-76. This list indicates where each of the species noted was figured and described.
1888. BEECHLER, CHAS. Keokuk group at Crawfordsville, Indiana. Am. Geol., Vol. 2, pp. 407-412. Gives a list of fossils occurring there.
1891. BEECHLER, CHAS. The rocks at St. Paul, Indiana, and vicinity. Am. Geol., Vol. 7, 1891, p. 179. Divides the beds at St. Paul into five horizons.
1873. BORDEN, W. W. Clark and Floyd Counties. Geol. Surv. of Ind., 1873, pp. 134-189.
1874. BORDEN, W. W. Jefferson County. Geol. Surv. of Ind., 1874, pp. 135-186. Gives sections through Devonian and Niagara rocks, with a few of the characteristic fossils of the different horizons; also Whitfield's determinations of Black Shale fossils.
1874. BORDEN, W. W. Scott County. 6th Ann. Rep't Geol. Surv. of Ind., 1874, pp. 112-134. Gives list of the New Albany Shale fossils found in Scott County, also list of fossils from the limestone at Falls of the Ohio and Silver Creek, Clark County.
1875. BORDEN, W. W. Jennings County. Geol. Surv. of Ind., 1875, pp. 146-180. The more common New Albany Shale fossils found in the county are mentioned.
1875. BORDEN, W. W. Geol. Surv. of Ind., 1875, Ripley County, pp. 181-202. The author gives a number of Lower Silurian fossils, with their relative positions in sections of these rocks.
1883. BROWN, R. T. List of fossils in Morgan County. 13th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., p. 85. Includes species from Knobstone, Keokuk and St. Louis groups.

1854. CASSEDAY, SAMUEL A. Abdruck, a. d. Zeitschr. d. deutscher geologischen Gesellschaft, Jahrg., 1854, p. 237. Describes the new genus *Butocrinus* and two new species of the same from Spergen Hill. For translation of same see 18th Rep't Ind. Dept. of Geol. and Nat. Hist., 1893.
1860. CASSEDAY, S. A. AND LYON, S. S. Description of two new genera and eight new species of fossil Crinoidae from the rocks of Indiana and Kentucky. Proc. Am. Acad. of Arts and Sci., Vol. V, 1860, pp. 16-31. Describes two new species without figures from the Subcarboniferous of Montgomery County: *Dichocrinus polydactylus* and *Dichocrinus ficus*.
1851. CHRISTY, D. On the Goniatite limestone of Rockford, Jackson County, Indiana. Proc. Am. Assoc. Adv. Sci., Vol. 5, 1851, pp. 76-80. The Goniatites are stated to occur in a limestone in the middle of the Black Shale.
1843. CLAPP, A. The geological equivalents of the vicinity of New Albany, Indiana, as compared with those described in the Silurian system of Murchison. Phila. Acad. of Sci. Proc., Vol. I, pp. 18-19, 171-178, 1843.
1890. CLAYPOLE, E. W. Paleontological notes from Indianapolis. Am. Geol., Vol. 5, pp. 255-260, 2 figs. *Eurysoma newlini*, a new genus and species from the Waterlime beds at Kokomo, is described. *Eurypterus lacustris* is reported from the same locality.
1894. CLAYPOLE, E. W. A new species of *Carcinosoma*. Am. Geol., Vol. 13, 1894, pp. 77-79, pl. 4. Describes a new species, *C. ingens*, from the Waterlime beds at Kokomo. *Carcinosoma* is proposed in place of *Eurysoma*, which was preoccupied.
1873. COLLETT, JOHN. Geology of Lawrence, Knox and Gibson Counties. Ind. Geol. Surv., 1873, pp. 260-430. Mention is made of fossils noted in local sections.
1875. COLLETT, JOHN. List of fossils found in the Keokuk group at Crawfordsville, Indiana. 7th Ann. Rep't Geol. Surv. of Ind., 1875, pp. 376-381.
1880. COLLETT, JOHN. Geology of Putnam County. Rep't Geol. Surv. Ind., pp. 397-422, 1880. Gives lists of the more common fossils found in the Chester, St. Louis, Keokuk and Knobstone groups.
1882. COLLETT, JOHN. Geological Survey of Jasper County. 12th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., 1882, pp. 65-76. Gives lists of fossils found in the county.

1883. COLLETT, JOHN. Geology of Posey County. 13th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., 1883, pp. 45-68. A number of Coal Measure fossils are noted.
1879. COPE, E. D. The relations of the horizons of extinct vertebrata of Europe and North America. U. S. Geol. and Geog. Surv. of the Territories, Bull. Vol. V, pp. 33-54, 1879.
1884. COPE, E. D., AND WORTMAN, J. L. Postpliocene vertebrates of Indiana. 14th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., 1884, pp. 3-41.
1842. CONRAD, T. A. Observations on the Silurian and Devonian systems of the United States, with descriptions of new organic remains. Jour. Acad. Nat. Sci. Phila., Vol. 8, pp. 228-280, pl. 12-17. Three new species from Silurian rocks are described: *Delthyris acutilirata*, *Atrapa capax*, and *Pleurotomaria biles*.
1855. CONRAD, T. A. Description of a new species of *Pentamerus*. Proc. Phila. Acad. Nat. Sci., 1855, p. 441. Describes *P. laqueatus* from Delphi, Indiana.
1858. NORWOOD AND PRATTEN. Notice of *Producti* found in the Western States and Territories, with description of twelve new species. Proc. Phila. Acad. Nat. Sci., Vol. 3, 2d ser., pp. 5-20, pls. 1-2.
1874. CORNETT, W. T. S. List of fossils found in Jefferson County, Indiana. Geol. Surv. of Ind., 1874, pp. 182-186.
1874. CORNETT, W. T. S. Indianapolis Journal, July 10, 1874. Geology of the Madison hills. The author announces the discovery of a stratum of Lower Silurian fossils in rocks called Upper Silurian in Borden's report.
1875. CORNETT, W. T. S. Geol. Survey of Ind., 1875, p. 183. Letter to W. W. Borden concerning the discovery of Lower Silurian fossils in strata previously considered Upper Silurian.
1870. COX, E. T. Dubois and Pike Counties. 2d Ann. Rep't Geol. Surv. Ind., pp. 192-287. Gives lists of fossils from different sections.
1875. COX, E. T. Vanderburg, Owen, and Montgomery Counties. Geol. Surv. Ind., 1875, pp. 240-422. Gives list of fossils from Crawfordsville.
1875. COX, E. T. Huntington County. Geol. Survey of Ind., 1875, p. 124. He names seven species of Brachiopoda and corals from the Niagara of Huntington County, Indiana.

1875. COX, E. T. Vigo County. Geol. Survey of Ind., 1875, pp. 78-115. Several species of Coal Measure fossils are noted in connection with geological sections.
1848. COZZENS, ISAACHAR. Description of three fossils from the Falls of the Ohio. Ann. N. Y. Lyceum, Nat. Hist., Vol. 4, pp. 157-159, pl. X, 1846. Describes *Ptilolites ohioensis*, *Pentagonia peersii*, and *Conulites elevata*.
1885. DAVIS, WILLIAM J. A monograph of the fossil corals of the Silurian and Devonian rocks of Kentucky, Part II. Geol. Surv. of Ky., 1885, pp. I-XIII, pls. 1-139. The volume illustrates about 300 species of corals, 170 of which are new but not described. Nearly all of the specimens figured are from Louisville or the Falls of the Ohio.
1889. DENNIS, D. W. Analytical key to the fossils of Richmond, Indiana, pp. 1-48.
1888. DRYER, CHAS. R. Geology of Allen County. 16th Ann. Rep't Ind. Dept. of Nat. Hist. and Geol., 1888, p. 126. Mentions two species: *Strophodonta profunda* and *Spirifera radiata*.
1896. DUDEN, HANS. Some notes on the Black Slate or Genesee Shale of New Albany, Indiana. 21st Ann. Rep't Ind. Dept. Geol. and Nat. Res., pp. 108-119, pls. 2-3. Describes the following species of fossil plants from the black shale: *Parenchymophycus asphalticum*, *Palaeophycus new-albanense*, *Palaeophycus lineare*, *Sporangites radiatus*.
1881. ELROD, M. N. Geology of Bartholomew County. Ind. Dep't Geol. and Nat. Res., 1881, pp. 150-213. Gives list of Harts-ville fossils.
1882. ELROD, M. N. Geology of Decatur County. Ind. Dep't Geol. and Nat. Res., 1882, pp. 100-152. Gives lists of Silurian and Devonian fossils.
1883. ELROD, M. N. List of fossils found in Rush County. 13th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., 1883, pp. 97-98. Includes Niagara and Devonian fossils.
1883. ELROD, M. N. Geology of Fayette County. 13th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., 1883, pp. 41-60. Gives list of Paleozoic fossils.
1884. ELROD, M. N. Geology of Marion County. Ind. Dept. Geol. Nat. Res., 1884, pp. 61-72. Gives list of Hudson River fossils.

1876. ELROD, M. N., AND MCINTIRE, E. S. Report of a geological survey of Orange County. Rep't Geol. Surv. Ind., pp. 203-239, 1876. Lists of more common fossils and the geological position of *Paolia vetusta* are shown on pp. 206, 207, 221.
1891. ELROD, M. N., AND BENEDICT, A. C. List of fossils found in Wabash County. 17th Rep't Ind. Dept. of Geol. and Nat. Hist., 1891, pp. 198-199. The list includes forty species, almost half of which are Cephalopoda, from Niagara strata.
1878. ETHERIDGE, R. Paleontology of the coasts of the Arctic lands visited by the British expedition under Captain Sir Geo. Nares, R. N., K. C. B., F. R. S. Quart. Jour. Geol., Vol. 34, pp. 568-639, pl. 25-29, 1878. Mentions *Archimedes arctica* as common to Carb. of Indiana and Spitzbergen.
1886. FABER, C. L. Remarks on some fossils of the Cincinnati group. Jour. Cin. Soc. Nat. Hist., Vol. IX, No. 1, 1886, pp. 14-20, pl. 1. Describes *Cyrtoceras tenuiseptum* n. sp. from the Hudson River group at Versailles.
1888. FOERSTE, A. F. A study of the head of typical forms of *Lichas breviceps* from the Niagara of Waldron, Ind. Bull. Denison Univ., Vol. III, pl. XIII, fig. 21.
1890. FOERSTE, A. F. Notes on Clinton group fossils, with special reference to collections from Indiana, Tennessee and Georgia. Proc. Bost. Soc. Nat. Hist., Vol. 24, 1889-90, pp. 263-352, pls. 5-9. Several species from the Clinton group at Hanover, Indiana, are described or mentioned.
1891. FOERSTE, A. F. Fossils of the Clinton group in Ohio and Indiana. Geol. Surv. Ohio, Vol. VII, pp. 516-601. Describes some new species, gives figures of all the Ohio and Indiana fossils mentioned, together with notes on the same. The Indiana localities of seventeen fossils are given. He considers the beds just below the Waldron Shales in Indiana to represent the Clinton group.
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1895. FOERSTE, A. F. An account of the Middle Silurian rocks of Ohio and Indiana. Jour. Cin. Soc. Nat. Hist., Vol. 18, 1895, pp. 161-191, pl. 7. Sections in Southeastern Indiana are correlated with others in Ohio. Lists of fossils are given from several localities in Southeastern Indiana.

1896. FOERSTE, A. F. A report on the geology of the Middle and Upper Silurian rocks of Clark, Jefferson, Ripley, Jennings, and southern Decatur Counties, Ind. 21st Ann. Rep't Ind. Dept. Geol. Nat. Res., pp. 212-288. Lists of fossils from a number of localities in the region are given.
1874. GARDNER, JAS. Tripoli. Geol. Surv. of Ind., 1873, pp. 423-425, fig. 1-5. The material reported upon is from above coal, K., Dubois County; it is composed mainly of sponge spicules.
1835. GORBY, S. S. A new Crinoid. Hoosier Mineralogist and Archeologist, Vol. 1, No. 10, 1885. Describes without figure *Eucalyptocrinus elrodi* from Hartsville, Indiana.
1886. GORBY, S. S. Geology of Washington County. 15th Ann. Rep't Ind. Dept. of Geol. and Nat. Hist., 1885-'86, pp. 117-153. Gives a list of about one hundred and twenty species of Warsaw fossils; also a number of fossils from the other formations of the county.
1886. GORBY, S. S. Geology of Tippecanoe County. 15th Ann. Rep't Ind. Dept. of Geol. and Nat. Hist., 1885-'86, p. 83. Mentions half a dozen species of St. Louis fossils.
1886. GORBY, S. S. The Wabash Arch. 15th Ann. Rep't Ind. Dept. of Geol. and Nat. Hist., p. 236. Notes a few Niagara fossils at Kentland, and some Hudson River fossils from the same locality which he supposes to have been forced up from the underlying Lower Silurian.
1888. GORBY, S. S. Geology of Miami County. 16th Ann. Rep't Ind. Dept. of Geol. and Nat. Hist., 1888, p. 181. Gives six species of Niagara fossils.
1886. GORBY, S. S., AND LEE, S. E. Geology of Boone County. 15th Ann. Rep't Ind. Dept. of Geol. and Nat. Hist., 1885-86, p. 167. Notes the finding of *Rhynchonella capax* in the Drift.
1880. GREEN, G. K. Geology of Monroe County. Rep't Geol. Surv. Ind., 1880, pp. 427-449. Gives lists of Subcarboniferous fossils from several localities in the county.
1883. GURLEY, W. F. E. New Carboniferous fossils. Bulletin No. 1, pp. 1-9, 1883. Danville, Ill. Three species from Indiana are described in this paper without figures. They are *Lingula cranfordsvillensis* from the Keokuk, *Dentalium acutisulcatum* and *Cypriocardia undulatum* from the Coal Measures.

1879. HAINES, MARY P. List of fossils found in the Lower Silurian rocks in the vicinity of Richmond, Indiana. 8th, 9th and 10th Ann. Rep'ts Ind. Geol. Surv., pp. 201-204. This list is based upon Mrs. Haines' private collection of fossils.
1843. HALL, JAS. Notes explanatory of a section from Cleveland, Ohio, to the Mississippi River, in a southwest direction, with remarks upon the identity of the Western formations with those of New York. Assoc. Am. Geol. Trans., 1843, pp. 267-293, plate.
1843. HALL, JAS. On the geographical distribution of fossils in the older rocks of the United States. Am. Jour. of Sci., Vol. 45, 1843, pp. 157-160, 162-163.
1844. HALL, JAS. Geographical distribution of fossils. Am. Jour. Sci., Vol. 47, 1844, pp. 117-118.
1851. HALL, JAS. Parallelism of the Paleozoic deposits of the United States and Europe. Foster and Whitney's Rep't on Lake Superior. Pt. II, 1851, pp. 285-318. Compares the Paleozoic rocks of the West with those of New York.
1856. HALL, JAS. Description of new species of fossils from the Carboniferous Limestones of Indiana and Illinois. Trans. Alb. Inst., Vol. 4, pp. 1-36. A large number of new species, all from the St. Louis group of Indiana and Illinois, with one exception, are described but not figured.
1857. HALL, JAS. Descriptions of Paleozoic fossils. 10th Reg. Rep't N. Y., 1857, pp. 41-186. Describes some new brachiopods from the Devonian and *Spirifer texta* from the Knobstone.
1858. HALL, JAS. Paleontology of Iowa. Geol. Surv. of Iowa, Vol. 1, Pt. 2, pp. 473-724, pls. 1-29. A number of the fossils which were described from the St. Louis L. S. at Spergen Hill, Indiana, in the Trans. of the Albany Institute, Vol. IV, are illustrated in this volume.
1860. HALL, JAS. Descriptions of new species of Crinoidea from the Carboniferous rocks of the Mississippi Valley. Bost. Jour. Nat. Hist., Vol. 7, pp. 261-328. The author describes six new species of Crinoids from the Keokuk at Crawfordsville. These are *Scaphiocrinus unicus*, *S. nodobranchiatus*, *S. robustus*, *S. aequalis*, *Cyathocrinus hoveyi* and *C. lyoni*.
1860. HALL, JAS. Upon the fossils of the Goniatite limestone in the Marcellus Shale of the Hamilton group in the eastern and central parts of the State of New York and those of the Goniatite beds of Rockford, Indiana; with some analogous forms

- from the Hamilton group. 13th Ann. Rep't Regents Univ. N. Y., 1860, pp. 95-112, figs. 1-22. A large list of new species from Rockford is described, most of which are not figured.
1861. HALL, JAS. Supplementary note. 14th Ann. Rep't Regents Univ. N. Y., 1861, p. 81. The age of the Rockford Goniatile beds and of the Black Shale is discussed. It is suggested that the former is the equivalent of the Chemung.
1861. HALL, JAS. Preliminary notice of the Trilobites and other Crustacea of the Upper Helderberg, Hamilton and Chemung groups. 14th Ann. Rep't Regents Univ. of N. Y., 1861, pp. 82-114. Three Trilobites from the Falls of the Ohio are described. *Dalmania calypso*, *D. pleione* and *Proteus crassemarginatus*.
1862. HALL, JAS. Notice of some new species of fossils from a locality of the Niagara group in Indiana, with a list of identified species from the same place. Trans. Albany Inst., Vol. 4, 1862, pp. 195-228. The new species described in this paper are figured in the 16th Ann. Rep't Regents Univ. of N. Y.
1867. HALL, JAS. Descriptions and figures of the fossil Brachiopoda of the Upper Helderberg, Hamilton, Portage and Chemung groups. Pal. of N. Y., Vol. 4, Pt. 1, 1867, pp. I-XIII, 1-422, pls. 1-63. A number of the species described occur at the Falls of the Ohio and elsewhere in Indiana rocks.
1878. HALL, JAS. Note upon the history and value of the term Hudson River in American geological nomenclature. Am. Assoc. Adv. Sci. Proc., Vol. 26, pp. 259-265, 1878. Abstract Am. Jour. Sci., 3d ser., Vol. 16, p. 482.
1879. HALL, JAS. The fauna of the Niagara group in Central Indiana. 28th Ann. Rep't N. Y. State Mus. Nat. Hist., 1879, pp. 99-199, pls. 1-34. The species occurring at Waldron, Indiana, are described and figured in this report.
1882. HALL, JAS. Descriptions of fossil corals from the Niagara and Upper Helderberg groups of Indiana. 12th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., pp. 271-375.
1882. HALL, JAS. Vancleve's fossil corals, identified and compiled by Dr. Jas. Hall. 12th Ann. Rep't Ind. Dept. Geol. Nat. Hist., 1882, pp. 239-318, pls. 1-28.
1884. HALL, JAS. Lamellibranchiata of the Upper Helderberg, Hamilton, Portage and Chemung groups (Monomyaria). Pal. N. Y., Vol. 5, Pt. 1, 1884, pp. I-X, 1-268, pls. 1-33, 81-92. The

following species are figured and described from the Falls of the Ohio: *Aviculopecten princeps*, *Pterinopecten reflexus*, *P. nodosus*, *Pterinea grandis*; *Glyptodesma occidentale*, *Limoptera cancellata*. *Pterinea grandis*, a new species from Scott County, is described.

1884. HALL, JAS. Descriptions of fossil corals from the Niagara and Upper Helderberg groups. 35th Ann. Rep't N. Y. State Mus. Nat. Hist., pp. 407-464, pls. 16, 23-30. Describes and figures a large number of new species from the Falls of the Ohio.
1884. HALL, JAS. Descriptions of the species of fossil Reticulate Sponges constituting the family Dictyospongia. 35th Ann. Rep't N. Y. State Mus. Nat. Hist., pp. 465-481, pls. 18-21. Species from the Keokuk at Crawfordsville are described.
1885. HALL, JAS. Lamellibranchiata (Dimyaria), Pal. N. Y., Vol. 5, Pt. I, pp. 269-561, pls. 34-96. Eighteen species from Indiana are described and figured in this volume, some of which are new.
1887. HALL, JAS. Corals and Bryozoa. Pal. of N. Y., Vol. 6, 1887, pp. I-XXVI, 1-298, pls. 1-66. In this volume Prof. Hall describes and figures about seventy species, many of which are new, from the "Corniferous Limestone" at the Falls of the Ohio.
1888. HALL, JAS. Pteropoda of the Niagara, Lower and Upper Helderberg, Hamilton and Waverly Groups. Pal. N. Y., Supplement Vol. 5, Pt. 2, pp. 5-7, pl. 104, 1888. Describes and figures *Tentaculites dextrhea* from Pendleton.
1888. HALL, JAS. Tubicolor Annelida, Pal. N. Y., Supplement Vol. 5, Pt. 2, pp. 8-24, pl. 116, 1888. Describes and figures *Cornulites proprius* from Waldron, and figures *Tentaculites richmondensis* Miller from Richmond.
1888. HALL, JAS. Supplement containing descriptions and illustrations of Pteropoda, Cephalopoda and Annelida. Pal. N. Y., Vol. 5, Pt. 2, 1888, pls. 114-129. Three Cephalopods from Indiana are figured in this supplement. These are *Gomphoceras minus* from the Falls of the Ohio, *Orthoceras indianense* and *O. icarus* from Rockford, Indiana.
1888. HALL JAS., AND CLARK, J. M. Trilobites and other Crustacea of the Oriskany, Upper Helderberg, Hamilton, Portage, Chemung and Catskill Groups. Pal. of N. Y., Vol. 7, 1888, pp. I-LXIV, 1-236, pls. 1-36. Two new species from what Hall considers a


- Schoharie grit horizon at Pendleton, Indiana, are described. These are *Poetus curvmarginatus* and *P. latimarginatus*. Other new species from the Falls of the Ohio are figured.
1892. HALL, JAS., AND CLARK, J. M. An introduction to the study of the genera of Paleozoic Brachaeopoda. Pal. of N. Y., Vol. 8, Pt. 1, 1892, pp. 182, 346. Two new Brachiopods from Indiana are described and figured in this volume. *Derbya ruginosa* from the Keokuk and *Pholidops calceola* from the Corniferous Ls.
1872. HALL, JAS., AND WHITFIELD, R. P. Descriptions of new species of fossils from the vicinity of Louisville, Kentucky, and the Falls of the Ohio. 24th Ann. Rep't Regents of the Univ. of N. Y., 1872, pp. 223-239. The plates were published in the 27th Ann. Rep't Reg Univ. N. Y., 1875, Nos. 9-13.
1844. HAYMOND, RUFUS. Notices of remains of Megatherium, Mastodon and Silurian fossils. Am. Jour. Sci., Vol. 46, pp. 294-296, 1844.
1887. HERRICK, C. L. A sketch of the geological history of Licking County, accompanying an illustrated catalogue of Carboniferous fossils from Flint Ridge, Ohio. Denison Univ. Bull., Vol. 2, pp. 62, 63. Gives descriptive notes on three Trilobites from Rockford, Indiana. They are *Phillipsia scitula* M. & W., *P. doris* (Hall) Winch. and *P. rockfordensis* Winch.
1891. HUBBARD, GEO. C. The Upper limits of the Lower Silurian at Madison, Indiana. Proc. Ind. Acad. Sci., 1891, pp. 68-70. Places the limit 50 feet above the Favistella reef.
1891. HUBBARD, GEO. C. The Cystideans of Jefferson County, Indiana. Proc. Ind. Acad. Sci., 1891, p. 68. Gives no list of species. Mentions Big Creek as a good locality for collecting.
1891. HUBBARD, GEO. C. Hudson River fossils of Jefferson County, Indiana. Proc. Ind. Acad. Sci., 1891, p. 68. Gives a summary by families of number of species. No specific names given.
1874. JAMES, U. P. Descriptions of new species of fossils from the Lower Silurian formation, Cincinnati group. Cin. Quart. Sci., Vol. 1, 1874, pp. 239-242. Describes a new species from Wayne County—*Avicula corrugata*—and mentions Indiana localities for some other species.
1886. JAMES, J. F. Cephalopoda of the Cincinnati group. Jour. Cin. Soc. Nat. Hist., Vol. 8, 1886, pp. 235-253. The paper contains a convenient key to the species of Cephalopoda and gives Indiana localities for a number of species.

1886. JAMES, J. F. Protozoa of the Cincinnati group Jour. Cin. Soc. Nat. Hist., Vol. IX, No. 3, pp. 244-252, 1886. Gives a synopsis of genera and species of the Protozoa of the Hudson River group. Notes *Labechia montifera* from Madison and *Stromatoceerium richmondense* Miller, Hudson River group, Richmond.
1892. JAMES, J. F. Manual of the Paleontology of the Cincinnati group. Jour. Cin. Soc. Nat. Hist., Pt. 3, in Vol. 15, No. 2, 1892, pp. 88-100; Pt. 4, Vol. 15, Nos. 3 and 4, pp. 144-160; Pt. 5, Vol. 16, 1894, pp. 178-208; Pt. 6, Vol. 18, 1895; Pt. 7, Vol. 18, pp. 115-140.
1897. JAMES, J. F. Article XII—Manual of the Paleontology of the Cincinnati group. Jour. Cin. Soc. Nat. Hist., Vol. XIX, No. 3, pp. 99-118. The following species from Indiana localities are included: *Xenocrinus baeri* M., Richmond, *Glyptocrinus decadactylus* H., Madison.
1889. KEYES, C. R. The Carboniferous Echinodermata of the Mississippi basin. Am. Jour. Sci., 3d Ser., Vol. 3, p. 186. (Gives table showing range of principal carboniferous genera.
1890. KEYES, C. R. Synopsis of American Carbonic Calyptræidæ. Proc. Phila. Acad. Nat. Sci., 1890, pp. 150-181, Pl. 2. Three species from Crawfordsville are figured—*Capulus sulcatus*, *C. equilateralis*, *C. infundibulum*—and one from the Coal Measures, *C. parvus*.
1896. KINDLE, E. M. The Whetstone and Grindstone rocks of Indiana. 20th Ann. Rep't Ind. Dept. Geol. and Nat. Res., 1895, p. 349. Describes occurrence of *Lepidodendrons* standing upright in the Whetstone quarries near French Lick, and republishes the original figure of *Paola vetusta*.
1889. KNOWLTON, F. K. Description of a problematic organism from the Devonian at the Falls of the Ohio. Am. Jour. Sci., 3d Ser., Vol. 37, 1889, pp. 202-209, fig. 1-3. The organisms are referred provisionally to the genus *Calcisphaera*.
1870. LESQUEREAUX, LEO. Description of new species, and an enumeration, with remarks on species already known. Geol. Surv. of Ill., Vol. 4, 1870, pp. 379-477, pls. 5-31. One new coal plant is described from Indiana, without figure—*Chondrites colletti*—and mention is made of another.
1875. LESQUEREAUX, LEO. Species of fossil marine plants from the Carboniferous Measures. Geol. Survey of Ind., 1875, pp. 135-145. Five new species are described and figured. Four of these are from Indiana and one from Illinois.

1875. LESQUEREAUX, LEO. Geol. Survey of Ind., 1875, p. 7. Eight species of fossil plants from the Millstone grit are given by Cox, which were determined by Lesquereaux.
1883. LESQUEREAUX, LEO. Principles of Paleozoic Botany and the fauna of the Coal Measures. 13th Ann. Rep't Ind. Geol. Surv., 1883, pp. 1-185, pls. 1-22. Gives descriptions of the fossil plants which have been and are likely to be found in Indiana.
1884. LESQUEREAUX, LEO. A list of the species of fossil plants found at each locality. 2d Geol. Surv. Pa., Vol. 3, p. 852. Gives list of species known from the Whetstone beds.
1849. LYELL, CHAS. A second visit to the U. S. Vol. II, pp. 269-278, London, 1849. Describes fossil *Sigilaria* at New Harmony and the Coral reef at Louisville.
1857. LYON, SYDNEY S. Description of new species of organic remains. Ky. Geol. Surv., Vol. 3, 1857, pp. 467-498, pls. 1-5. The following new crinoids from the Falls of the Ohio are figured and described: *Actinocrinus abnormis*, *Dalatocrinus lacus*, *Vasocrinus sculptus*, *Olavanites verneuili*, *O. angularis*, *Codaster alternatus*.
1859. LYON, SYDNEY S. AND CASSEDAY S. A. Description of nine new species from the Subcarboniferous rocks of Indiana and Kentucky. Am. Jour. of Sci. and Arts, Vol. XXIX, pp. 68-79, 1859. Describes five species without figures from the Indiana Subcarboniferous, *Cayathocrinus decadactylus*, *C. hexadactylus*, *Actinocrinus indianensis* and *Onychocrinus exculptus*, from Montgomery County, and *Actinocrinus coreyi*, from Washington County.
1859. LYON, S. S., AND CASSEDAY. Description of nine new species of Crinoidea from the Subcarboniferous rocks of Indiana. Am. Jour. Sci., Vol. 28, 2d ser., pp. 233-246, 1859. The species which are described here without figures are figured in the Geol. Surv. of Ill., Vol. 7.
1861. LYON, SIDNEY S. Descriptions of new Paleozoic fossils from Kentucky and Indiana. Proc. Acad. Nat. Sci. Phila., pp. 409-414, 1 plate, 1861. Describes two new species from strata just below the Hydraulic limestone at the Falls of the Ohio, *Onochocrinus exculptus* and *Megistocrinus spinulosus*.
1882. McCASLIN, DAVID S. Geology of Jay County. 12th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., 1882, p. 166. Gives a list of fifteen species from Niagara at Jay City.

1869. MCCHERNEY, J. H. Descriptions of Paleozoic rocks of the Western States, with illustrations. Trans. Chic. Acad. of Sci., Vol. 1, 1867-1869, pp. 1-57, pls. 1-9. Several species from the Coal Measures of Indiana are described, and also one from the Hudson River group, *Trematospira matheusoni*.
1865. MEEK, F. B. Descriptions of nine species of Crinoidea, etc., from the Paleozoic rocks of Illinois and some of the adjoining States. Proc. Phila. Acad. Sci., 1865, pp. 143-166. Describes some new Crinoids from Crawfordsville.
1869. MEEK, F. B. Description of new Crinoidea and Echinoidea from the Carboniferous rocks of the Western States, with a note on the Genus Onychaster. Proc. Phila. Acad. Nat. Sci., 1869-70, pp. 67-83. Describes *Calceocrinus bradleyi* from Crawfordsville.
1871. MEEK, F. B. Descriptions of new Western Paleozoic fossils, mainly from the Cincinnati group of the Lower Silurian series of Ohio. Proc. Phila. Acad. Sci., 1871, pp. 308-336. Refers *Homocrinus polydactylus* Shum. from Richmond, Indiana, to *Poteriocrinus* (*Dendrocrinus*) *polydactylus*.
1871. MEEK, F. B. On some new Silurian Crinoids and Shells. Am. Jour. Sci. and Arts, Vol. II, 3d ser., 1871, pp. 295-302. Describes two new Crinoids *Dendrocrinus casei* and *Lepocrinites moorei*, from Richmond, Indiana.
1872. MEEK, F. B. Descriptions of two new star-fishes and a Crinoid from the Cincinnati group of Ohio and Indiana. Am. Jour. of Sci. and Arts, Vol. III, 3d ser., p. 260. Describes *Glyptocrinus baeri* and *Stenaster grandis* from Richmond, Indiana.
1872. MEEK, F. B. Descriptions of two new star-fishes and a Crinoid from the Cincinnati group of Ohio and Indiana. Am. Jour. of Sci., 3d ser., Vol. 3, 1872, pp. 257-262. These descriptions, with illustrations, are republished in the Pal. of Ohio.
1873. MEEK, F. B. Spergen Hill fossils identified among specimens from Idaho. Am. Jour. Sci., 3d ser., Vol. 5, 1873, pp. 383-384.
1873. MEEK, F. B. Descriptions of invertebrate fossils of the Silurian and Devonian systems. Geol. Surv. of Ohio, Vol. I, Pt. II, pp. 1-243. Gives Indiana localities of many Lower Silurian fossils.
1860. MEEK, F. B., AND WORTHEN, A. H. Descriptions of new Carboniferous fossils from Illinois and other Western States. Proc.

Phila. Acad. Nat. Sci., 1860, pp. 447. Several fossils from Rockford are described, some of which are figured in Vol. 2, Geol. Surv. of Ill.

1861. MEEK, F. B., AND WORTHEN, A. H. Remarks on the age of the Goniatite Limestone at Rockford, Indiana, and its relations to the "Black Slate" of the Western States and to some of the succeeding rocks above the latter. Am. Jour. Sci., 2d ser., Vol. 32, pp. 167-177. Gives list of species from Rockford known to be identical with Chateau La. species in Missouri and Illinois.
1865. MEEK, F. B., AND WORTHEN, A. H. Descriptions of new Crinoidea, etc., from the Carboniferous rocks of Illinois and some of the adjoining States. Proc. Phila. Acad. Nat. Sci., 1865, pp. 155-166. Describes several Crinoids from Crawfordville.
1865. MEEK, F. B., AND WORTHEN, A. H. Contributions to the Paleontology of Illinois and other Western States. Proc. Phila. Acad. of Sci., 1865, pp. 251-275. *Gyroceras? rockfordensis* and *Nautilus (Cryptoceras) rockfordensis* are described from Rockford, Indiana.
1866. MEEK, F. B., AND WORTHEN, A. H. Invertebrate fossils of the Kinderhook group. Geol. Surv. of Ill., Vol. 2, 1866, pp. 145-166, pl. 14. Several species from Rockford originally described in Proc. Phila. Acad. Sci., 1860, are figured in this volume.
1868. MEEK, F. B., AND WORTHEN, A. H. Paleontology. Geol. Surv. of Ill., 1868, Vol. 3, Pt. 2, pp. 291-565, pls. 1-20. A number of fossils from Indiana, previously described in the Proc. Phila. Acad. of Sci. without illustrations, are figured in this volume.
1868. MEEK, F. B., AND WORTHEN, A. H. Fossils of the Hamilton group. Geol. Surv. of Ill., Vol. 3, 1868, pp. 419-449, pls. 10-12. A few Indiana species previously described in Proc. Chic. Acad., Vol. 1, and Proc. Acad. Nat. Sci. Phila., 1866, are figured in this volume.
1870. MEEK, F. B., AND WORTHEN, A. H. Descriptions of new species and genera of fossils from the Paleozoic Rocks of the Western States. Proc. Phil. Acad. Nat. Sci., 1870, pp. 22-64. A number of species from Indiana are described but not figured in this paper. Some of them have since been figured in Vol. 7, Geol. Surv. of Ill.
1873. MEEK, F. B., AND WORTHEN, A. H. Descriptions of invertebrates from the Carboniferous System.  Geol. Surv. of Ill.,

- Vol. 7, 1873, pp. 323-523, pls. 1-17. This paper figures a number of Crawfordsville Crinoids which were described by the authors without figures in the Proc. Phila. Acad. Nat. Sci., 1870, p. 22, and by Lyon and Cassiday in Am. Jour. Sci., Vol. 28, 2d ser., p. 233.
1874. MILLER, S. A. Monograph of the Gasteropoda of the Cincinnati group. Cin. Quart. Jour. Sci., Vol. 1, 1874, pp. 302-321, fig. 30-34. One new species from Richmond, Indiana (*Bellerophon mohri*) is described, and Indiana localities of several other species are given.
1874. MILLER, S. A. Monograph of the Lamellibranchiata of the Cincinnati group. Cin. Quart. Jour. Sci., Vol. 1, 1874, pp. 211-236, fig. 20-29. Several new species of *Tentaculites* and *Byrictia*, and some new *Lamellibranches* are described and figured from Richmond, Osgood and Versailles, Indiana.
1874. MILLER, S. A. Notice of *Modiolopsis pholadiformis* (Foster & Whitney). Cin. Quart. Jour. Sci., Vol. 1, 1874, p. 232. A Lamellibranch from Richmond is identified with this species.
1875. MILLER, S. A. *Crania reticularis*. Cin. Quart. Jour. Sci., Vol. 2, 1875, p. 280, fig. 22. This species is described from a specimen obtained from Brookville, Indiana.
1875. MILLER, S. A. Class Cephalopoda (Cuvier), as represented in the Cincinnati group. Cin. Quart. Jour. Sci., Vol. 2, 1875, pp. 121-134. Indiana localities are given for several species.
1875. MILLER, S. A. Monograph of the Class Brachiopoda of the Cincinnati group. Cin. Quart. Jour. Sci., Vol. 2, 1875, pp. 6-62. Indiana localities are given for a large number of the species considered.
1878. MILLER, S. A. Descriptions of a new genus and eleven new species of fossils. Jour. Cin. Soc. Nat. Hist., Vol. 1, 1878, pp. 100-108, pl. 3 and 4. Four new species from the Hudson River group of Indiana are described; these are *Cyrtolites magnus*, *Murchisonia multigruma*, *Cyrtoceras amoenum* and *Angelium cuneatum*.
1878. MILLER, S. A. Description of eight new species of *Holocystites* from the Niagara group. Jour. Cin. Soc. Nat. Hist., Vol. 1, No. 3, pp. 129-136, pls. V. and VI., 1878. Describes and illustrates with good figures the following new species: *H. brauni*, *H. ornatus*, *H. globosus*, *H. elegans*, *H. pleonus*, from the Niagara, Jefferson County, Indiana; *H. wetherbyi* Niagara, Ripley County, Indiana; *H. perlongus* Niagara, Waldron, Indiana.

1879. MILLER, S. A. Description of twelve new fossil species and remarks upon others. Cin. Soc. Nat. Hist., Vol. II, No. 2. 1879, pp. 104-118, pls. 9-10. Describes the following species from Niagara strata, Ripley County: *Holocystites tumidus*, *H. baculus*, *H. rotundus*, *H. subrotundus*, *H. dyeri*, *H. ventricosus*, *Pisocrinus gemmiformis*. From Osgood, *Stephanocrinus osgoodensis*.
1879. MILLER, S. A. Catalogue of fossils found in the Hudson River, Utica Slate and Trenton groups, as exposed in southeastern Indiana, the southwestern part of Ohio and northern part of Kentucky. Ind. Geol. Rep't, 1876-77-78
1879. MILLER, S. A. Remarks upon the Kaskaskia group, and descriptions of new species of fossils from Pulaski County, Kentucky. Jour. Cin. Soc. Nat. Hist., Vol. II, No. 1, pp. 31-42, 1879. The paper gives the views of Hall, Shumard and Worthen on the stratigraphic relations of the Kaskaskia group, and concludes that the name Kaskaskia must displace Chester in nomenclature by reason of ten years priority in publication.
1879. MILLER, S. A. Description of two new species from the Niagara group and five from the Keokuk group. Jour. Cin. Soc. Nat. Hist., Vol. II, No. 2, 1879, pp. 254-259, pl. XV. Describes *Cyathocrinus harrisi* and *Palaeaster crawfordsvillensis* from the Keokuk at Crawfordsville, and *Holocystites turbinatus* from the Niagara, Ripley County.
1881. MILLER, S. A. Observations on the unification of geological nomenclature, with special reference to the Silurian formation of North America. Jour. Cin. Soc. of Nat. Hist., Vol. IV, No. 3, pp. 267-293, 1881. Describes the Silurian rocks as they occur in Indiana and elsewhere in the United States, and discusses their paleontological features in detail.
1881. MILLER, S. A. Description of new species of fossils. Jour. Cin. Soc. Nat. Hist., Vol. IV, No. 3, pp. 259-262, pl. 6, 1881. Describes and figures one new species from the Hudson River group at Versailles and Osgood, Indiana, *Leperditia calcigena*.
1882. MILLER, S. A. Description of two new genera and eight new species of fossils from the Hudson River group, with remarks upon others. Jour. Cin. Soc. of Nat. Hist., Vol. V, pp. 34-44, pl. 1-2, 1882. One new sponge is described from Richmond, *Stromatocerium richmondense*. This was described as "pisolitic balls" by J. T. Plummer in the A. J. S., Vol. 44, p. 281.
1882. MILLER, S. A. Description of three new orders and four new families in the class Echinodermata and eight new species from the Silurian and Devonian formations. Jour. Cin. Soc. Nat.

Hist., Vol. V, 1882, pp. 221-231, pl. IX. Describes *Lichenocrinus tuberculatus*, from the Hudson River group three miles south of Osgood; *Cyclora pulcella*, from the Hudson River at Versailles, and *Poteriocrinus davisianus* and *P. nettlerothanus*, from the Upper Helderberg at Deputy, Indiana.

1882. MILLER, S. A. Descriptions of ten new species of fossils. Jour. Cin. Soc. Nat. Hist., Vol. V, 1882, pp. 79-88, pls. 3 and 4. Describes *Cyathocrinus crawfordsvillensis* from Crawfordsville.

1888. MILLER, S. A. The structure, classification and arrangement of American Paleozoic Crinoids into families. 16th Rep't Ind. Dept. of Geol. and Nat. Hist., 1888, pp. 302-326. The author indicates the systematic relations as understood by him of the Paleozoic genera, including those from Indiana.

1891. MILLER, S. A. Paleontology. 17th Rep't Ind. Dept. of Geol. and Nat. Hist., 1891, pp. 611-705, pls. I-XX. This paper describes and figures sixty-eight new species of Indiana fossils from the Carboniferous, Devonian and Silurian rocks; also several from Kentucky and Missouri.

1893. MILLER, S. A. Paleontology. 18th Rep't Ind. Dept. of Geol. and Nat. Hist., 1893, pp. 257-356, pls. I-XII. The author describes forty new species from the Carboniferous, Devonian and Silurian rocks of Indiana. Several new species from Ohio, Kentucky, Missouri and Kansas are described.

1894. MILLER, S. A., AND FABER, CHAR. Jour. Cin. Soc. Nat. Hist., Vol. 17, pp. 22-33, pl. 1. New species of fossils from the Hudson River group and remarks upon others. The authors describe a new Lamellibranch—*Bodmania insuetum*—which is the type of a new genus from Richmond, Indiana.

1888. MILLER, S. A., AND GURLEY, F. E. Description of some new genera and species of Echinodermata from the Coal Measures and Subcarboniferous rocks of Indiana, Missouri and Iowa. 16th Rep't Ind. Dept. of Geol. and Nat. Hist., 1888, pp. 326-373, 10 pls. Describes and figures thirty-one new species of Crinoidea from the Keokuk group of Indiana.

1890. MILLER, S. A., AND GURLEY, W. F. E. Description of some new genera and species of Echinodermata, from the Coal Measures and Subcarboniferous rocks of Indiana, Missouri and Iowa. Jour. Cin. Soc. Nat. Hist., 1890, pp. 3-25, pl. 1-4. The following new species of crinoids are described from Crawfordsville: *Agaricocrinus splendeus*, *Onychocrinus ulrichi*, *Batocrinus ulrichi*, *Batocrinus marinus*, *B. jucundus*, *Poteriocrinus granili-neus*, *P. crawfordsvillensis*, *Scaphiocrinus manus*.

1895. MILLER, S. A., AND GURLEY, WM. F. E. Description of some new species of invertebrates from the Paleozoic rocks of Illinois and adjacent States. Bull. No. 3, Ill. State Mus. Nat. Hist., 1893, pp. 1-81, pls. 1-8. The paper describes from Indiana two new Trilobites—*Lichas hanoverensis*, *Lichas byrnesanus*, *Lingula indianensis*, *Conularia gratiosa*, *C. spergensis* and a number of new Crinoids.
- . MILLER, S. A., AND GURLEY, WM. F. E. New and interesting species of Paleozoic fossils. Bull. 7, Ill. State Mus. Nat. Hist. pp. 1-89, pls. 1-5. Several Indiana species are described.
1896. MILLER, S. A., AND GURLEY, WM. F. E. New species of Echinodermata and a new Crustacean from the Paleozoic rocks. Bull. 10 Ill. State Mus. Nat. Hist., p. 90, pl. 5. Describes *Eurypterus kokomoensis* from Kokomo.
1896. MILLER, S. A., AND GURLEY, WM. F. E. New species of paleozoic invertebrates from Illinois and other States. Bull. 11 Ill. State Mus. Nat. Hist., pp. 1-50, pls. 1-5. Describes three *Gastropods*, a *Goniatite*, an *Orthoceras* and a *Conularia*.
1897. MILLER, S. A., AND GURLEY, WM. F. E. New species of Crinoids, Cephalopods and other Paleozoic fossils. Bull. 12 Ill. State Mus. Nat. Hist., pp. 1-69, pls. 1-5. Describes several species from Indiana.
1878. MILLER, S. A., AND DYER, C. B. Contributions to Paleontology. Jour. Cin. Soc. Nat. Hist., Vol. 1, 1878, pp. 24-39, pls. 1-2. Three new species from Waldron are described—*Codaster pulchellus*, *Eucalyptocrinus tuberculatus*, and *Spirijera (?) waldronensis*. A new species from Versailles, Indiana—*Conularia formosa*—is described and figured.
1892. MILLER, S. A., AND FABER, C. Some new species and new structural parts of fossils. Jour. Cin. Soc. Nat. Hist., Vol. 15, 1892, pl. 1. A new species from the Niagara at Madison, Indiana—*Holocystites affinis*—is described and figured.
1894. MILLER, S. A., AND FABER, C. L. Description of some Cincinnati fossils. Jour. Cin. Soc. Nat. Hist., Vol. 17, 1894, pp. 137-158, pl. 7 and 8. The authors describe the following new species from Indiana: *Gomphoceras indianensis*, *Hyolithes versaillesensis*, *Hyolithes (?) dubius* and *Berychia hammelli*.
1886. MOORE, D. R. Fossil corals of Franklin County, Indiana. Bull. Brookville Society of Nat. Hist., No. 2, 1886, pp. 50-51. This paper gives a list of twenty-three species from the Upper and Lower Silurian, and four from the Drift.

1886. MOORE, D. R. Two hours among the fossils of Franklin County, Indiana. Bulletin of the Brookville Society of Natural History, No. 1, pp. 44-45. The paper gives a list of seventeen Lower Silurian fossils.
1893. MOORE, JOS. The recently found *Castoroides* in Randolph County, Indiana. Am. Geol., Vol. 12, 1893, pp. 69-74, pl. 3. *Castoroides ohioensis* Foster.
1890. MOORE, JOS. Concerning a skeleton of the great fossil beaver, *Castoroides ohioensis*. Jour. Cin. Soc. of Nat. Hist., Oct. 1890, pp. 138-169. Gives detailed description and twenty-five figures of a specimen from Randolph County, Indiana.
1890. MOORE, JOS. Concerning some portions of *Castoroides ohioensis* not heretofore known. Proc. Am. Assoc. Adv. Sci., Vol. 39, 1890, pp. 265-267. Specimen from Randolph County.
1873. NEWBERRY, J. S. Descriptions of fossil fishes. Geol. Surv. of Ohio, Vol. I, Pt. II, pp. 247-355. The author refers to the species referred incorrectly by Owen and Norwood to the Upper Silurian at Madison (p. 262), and calls attention to a bone bed at North Vernon, Indiana. Reports *Gyrocanthus compressus* from Dearborn County.
1879. NEWBERRY, J. S. List of fossils of Harrison County. 8th, 9th and 10th Ann. Rep'ts Geol. Surv. Ind., 1879, pp. 341-349. The list of fossils by Collett has appended a list of species of fishes determined by Newberry. The new species described are *Chomatodus selliformis*, *C. angustus*, *C. obliquus*, *Lisgodus affinis*, *Orodus colletti*, *Helodus laevis*, *Deltodus cinctus*, *Petalodus knappi*, and *Archaeobatis gigas*. The last genus is also new.
1890. NEWBERRY, JOHN S. The Paleozoic fishes of North America. Monog. U. S. Geol. Surv., Vol. 16, 340 pages, 53 pls., Washington, 1890. A few species from Indiana are figured.
1866. NEWBERRY, J. S., AND WORTHEN, A. H. Descriptions of new species of Vertebrates, mainly from the Subcarboniferous Limestone and Coal Measures of Illinois. Geol. Surv. of Ill., Vol. 2, 1866, pp. 11-141, pls 1-13. Five species of fishes from Posey County are described—*Cladodus gracilis*, *Diplodus latus*, *D. compressus*, *Ctenoptychius semicircularis*, *Edestus minor*—and one from Rockford, *Orodus multicarinatus*.
1889. NETTLEROTH, HENRY. Kentucky fossil shells. A monograph of the fossil shells of the Silurian and Devonian rocks of Kentucky. Ky. Geol. Surv., pp. 1-245, pls. I-XXXVI, Frankfort, Ky. A large number of Devonian fossils from Clark County, Indiana, and the Falls of the Ohio are figured and described.

1888. NEWELL, FREDERICK H., Niagara Cephalopods from Northern Indiana. Pr. Bost. Soc. Nat. Hist., Vol. 23, pp. 466-486.
1875. NICHOLSON, H. ALLEYNE. Description of the corals of the Silurian and Devonian systems. Geol. Surv. of Ohio, Vol. II, 1875, pp. 183-242. The author reports *Eridophyllum strictum* from the Corniferous at Louisville.
1875. NICHOLSON, H. ALLEYNE. Descriptions of Amorphozoa from the Silurian and Devonian formations. Geol. Surv. of Ohio, Vol. II, 1875, pp. 245-255. Reports *Dictyostroma undulata* from the Niagara of Louisville, Ky.
1848. NORWOOD, J. G. Proc. Bost. Soc. Nat. Hist., Vol. 2, 1848, p. 102. In a letter to the society, Norwood announces the discovery of fossil fishes at a locality sixteen miles north of Madison.
1848. NORWOOD, JOS. G., AND OWEN, D. D. Description of a new fossil fish from the Paleozoic rocks of Indiana. Am. Jour. Sci., 2d Ser., Vol. 1, pp. 367-371, figs. 1 and 2. The fish described is *Macropetalichthys rapheidolabis*, from the Corniferous.
1858. NORWOOD, J. G., AND PRATTON, HENRY. Notice of the genus *Chonetes*, as found in the Western States and Territories with descriptions of eleven new species. Proc. Phila. Acad. Nat. Sci., 1855-1858, Vol. 3, 2d ser., pp. 23-31, pl. 1. Figures *C. nana* from Falls of the Ohio.
1858. NORWOOD, J. C., AND PRATTON, HENRY. Notice of Producti found in the Western States and Territories, with descriptions of twelve new species. Proc. Phila. Acad. Sci. 1855-58, Vol. 3, 2d ser., pp. 522, pls. 1-2. Describes and figures *P. flemingii* de Kon. from the "Mountain Limestone," and from the Coal Measures in Posey County *P. buchianus* de Kon., *P. fimbriatus* Sow., *P. wabashensis* nov. sp., *P. flemingii* de Kon., *P. undiferous* de Kon.
1843. OWEN, D. D. On fossil palm trees in Indiana. Am. J. S. and A., Vol. 45, 1843., pp. 336-337 (abstract). Describes specimens from the Coal Measures at Big Creek, twelve miles from New Harmony and Bug Creek.
- 1859-60. OWEN, RICHARD. Report of a geological reconnoissance of Indiana, 1859-60, pp. 1-368. Gives lists of the characteristic Lower Silurian, Upper Silurian and Devonian fossils found in the State. The following fossils are figured: *Siphonia digitata*, *Halysites sexto-attenuatus*, *Bucania euomphaloides*, *Gyroceras rhombolinearis*, *Columnaria inequalis*, *Cerriopora lyra*, *Lithostrotion canadense*, *Pileopsis pabulocrinus*, *Conularia crawfordsvillensis*. Figures very poor.

1881. PHINNEY, A. J. Delaware County. 11th Ann. Rep't Ind. Dept. Geol. and Nat. Hist., pp. 126-149. Gives list of fossils found in the county.
1843. PLUMMER, JOHN T. Suburban geology about Richmond, Indiana. Am. Jour. Sci., Vol. 44, 1843, p. 281. Describes "pisolitic balls" which have since been described by S. A. Miller as a sponge, *Stromatocerium richmondense*.
1858. PROUT, H. A. Descriptions of Bryozoa from the Paleozoic rocks of the Western States and Territories. Trans. St. Louis Acad. Sci., Vol. 1, pp. 443-452, 571-581, pls. 15-18. Two new species from the Falls of the Ohio are described—*Semicoscium rhomboideum*, *Limaria falcata* and *Semicoscium tuberculatum*.
1843. ROGERS, H. D. On Marcellus and Hamilton of the West and South. Am. Jour. Sci., Vol. 41, pp. 161-162, 1843.
1866. ROMINGER, C. Observations on Chaetetes and some related genera in regard to their systematic position, with an appended description of some new species. Proc. Phila. Acad. of Sci., 1866, pp. 113-123. Three new species from Indiana are described—*Fistulipora neglecta*, *F. halli* and *F. spergensis*.
1876. ROMINGER, C. Fossil corals. Geol. Surv. of Mich., Vol. 3, Pt. 2, 1876, pp. 1-155, pls. 1-55. The paper describes or mentions about fifty species of corals from Indiana, many of which are figured.
1892. ROMINGER, C. On the occurrence of typical Chaetetes in the Devonian strata at the Falls of the Ohio, and likewise in the analogous beds in Germany. Am. Geol., Vol. 10, pp. 56-62, pl. 3. Describes one new species, *Chaetetes ponderosus*.
1890. ROWLEY, R. K. Some observations on the natural casts of Crinoids and Blastoids from Subcarboniferous Limestones of Indiana, Iowa, Illinois, Kentucky and Alabama. Am. Geol., Vol. 6, pp. 66-67.
1886. SEELEY, H. M. The genus *Strophochetus*: Distribution and species. Am. Jour. Sci., ser. 3, Vol. 32, p. 31. Sponge found at Madison. Describes *S. richmondensis* Miller from Richmond and Madison.
- SHALER, N. S. On the fossil Brachiopods of the Ohio Valley. Ky. Geol. Surv., pp. 1-44, pls. 1-8. This paper gives very full descriptions, with tables of measurement of several Lower Silurian species of the family *Strophomenidae*, together with notes on their geological and geographical range. It bears no date.

1858. SHUMARD, B. F. Description of new fossil Crinoidea from the Paleozoic rocks of the western and southern portions of the United States. From St. Louis Acad. Sci., Vol. I, pp. 71-80, pl. 1. Describes and figures *Homocrinus polydactylus* from the Lower Silurian at Richmond.
1858. SHUMARD, B. F. Descriptions of new species of Blastoidea from the Paleozoic rocks of the Western States, with some observations on the structure of the summit of the genus *Pentremitea*. Trans. St. Louis Acad. Sci., Vol. 1, pp. 238-248, pl. 9. Describes three species from Indiana—*Codaster pyramidatus*, *C. americanus*, *Pentrimites grosvenore*.
1871. SMITH, S. I. Notice of a fossil insect from the Carboniferous formation of Indiana. Am. Jour. Sci., Ser. 3, Vol. 1, pp. 44-46. The paper describes a new insect, *Paolia vetusta*, from the Hindostan Whetstone beds at French Lick. The original figure is republished in the 20th Ann. Rept. Geol. Surv. of Ind., p. 356.
1858. STEVENS, R. P. Description of new Carboniferous fossils from the Appalachian, Illinois and Michigan coal fields. Am. Jour. Sci., 2d ser., Vol. 25, pp. 258-265. Describes *Chiton parvulus* from Bergen Hill (Spergen Hill?).
1883. ST. JOHN, ORESTES, AND WORTHEN, A. H. Descriptions of fossil fishes. Geol. Survey of Ill., Vol. VII, 1883, pp. 57-264. Records *Taeniodus regularis* nov. sp. from Bedford, and *Orthopleurodus carbonarius* (N. and W.) from Posey County.
1886. THOMPSON, MAURICE. Fossil mammals of the Post-Pliocene in Indiana. 15th Ann. Rep't of Ind. Dept. of Geol. and Nat. Hist., 1885 and '86, pp. 283-285. Gives brief descriptions and localities of all species certainly identified.
1891. THOMPSON, MAURICE. Geology of Carroll County. 17th Rep't Ind. Dept. of Geol. and Nat. Hist., 1891, pp. 171-191. Mentions a few fossils found at Delphi, by which he identified Niagara and Devonian strata at this point.
1886. THOMPSON, W. H. A Geological Survey, Clinton County. 15th Ann. Rep't Ind. Dept. of Geol. and Nat. Hist., 1885-86, p. 155. Notes the discovery of *Elephas primigenius*.
1879. ULRICH, E. O. Description of a Trilobite from the Niagara group of Indiana. Jour. Cin. Soc. Nat. Hist., Vol. II, No. 2, pp. 131-134, 1879. Describes and figures *Calymene nasuta* from the Niagara group at Osgood, Ripley County.

1879. ULRICH, E. O. Descriptions of new genera and species of fossils from the Lower Silurian about Cincinnati. Jour. Cin. Soc. Nat. Hist., Vol. II, No. 1, pp. 8-30, 1879. Describes and figures *Tellinomya cingulata* n. sp., found at Marble Hill, near Madison, and at Louisville, Kentucky.
1880. ULRICH, E. O. Catalogue of fossils occurring in the Cincinnati group of Ohio, Indiana and Kentucky. 31 pages, Cincinnati, 1880.
1882. ULRICH, E. O. American Paleozoic Bryozoa. Jour. Cin. Soc. Nat. Hist., Vol. V, 1882, pp. 232-257, pls. 10-11. Notes the following species from Osgood, Indiana: *Diplotrypa milleri* n. sp., *Monotrypa subquadrata* n. sp., *Callopora elegantula*.
1883. ULRICH, E. O. American Paleozoic Bryozoa. Jour. Cin. Soc. Nat. Hist., Vol. VI, pls. 10-14, pp. 245-279, 1883. Describes and figures the following new species from the Niagara group of Indiana: *Trematopora halli* n. sp. from Waldron, *T. whitfieldi* n. sp. from Waldron, and *Idiotrypa parasitica* n. sp. from Osgood.
1886. ULRICH, E. O. Descriptions of new Silurian and Devonian fossils. Contributions to American Pal., Vol. I, No. 1, 1886, pp. 3-35, pls. 1-3, Cincinnati. A number of new species of Bryozoa and Gastropods are described from Indiana rocks, also a new Brachiopod from the Knobstone—*Rhynchonella greeniana*—and a new species of foraminifera—*Moellerina greenei*.
1888. ULRICH, E. O. A correlation of the Lower Silurian horizons of Tennessee and of the Ohio and Mississippi valleys with those of Canada. Am. Geol., Vol. I, pp. 100-110, 179-190, 305-315; Vol. II, pp. 39-44, 1888. Gives description of paleontology, stratigraphy and structure of the Lower Silurian of the Ohio Valley.
1888. ULRICH, E. O. A correlation of the Lower Silurian horizons of Tennessee and the Ohio and Mississippi valleys with those of New York and Canada. Am. Geol. I, 1888, pp. 39-44, 100-110, 305-315.
1890. ULRICH, E. O. New and little known American Paleozoic Ostracoda. Jour. Cin. Soc. Nat. Hist., Vol. 13, 1890, pp. 104-137, 173-211, pls. 7-18. Nearly thirty new species from Indiana are described in this paper.
1890. ULRICH, E. O. New Lamellibranchiata. Am. Geol., Vol. 6, Sept., 1890.

1893. ULRICH, E. O. New and little known Lamellibranchiata from the Lower Silurian rocks of Ohio and adjacent States. Geol. Surv. of Ohio, Vol. VII, pp. 627-693, pls. 45-56. Describes the following new species from Indiana: *Ichthyrodonta miseneri*, *Ichthyrodonta modioliformis*, *Modiolodon subrectus*, *M. declivis*, *M. subovalis*, *Clionychia excavata*.
1894. ULRICH, E. O. The Lower Silurian Ostracoda of Minnesota. Geol. and Nat. Hist. Surv. Minn., Vol. III, pp. 633-693, pls. 43-46, 1894. The author mentions two species of Ostracoda occurring at Richmond and Versailles which he figures; they are *Ceratopsis chambersi* Miller and *Tetradella quadrilirata* H. & W.
1897. ULRICH, E. O. The Lower Silurian Gastropoda of Minnesota. Geol. of Minn., Vol. 3, Pt. 2, pp. 815-1081, pls. 61-82. A large number of Gastropods from Indiana rocks are figured, some of which are new species.
1897. ULRICH, E. O. The Lower Silurian Ostracoda of Minnesota. Geol. of Minn., Vol. 3, Pt. 2, pp. 629-693, pls. 43-46. Two species are mentioned from the Cincinnati group of Indiana — *Ceratopsis chambersi* var. *robusta* and *Tetradella quadrilirata* Hall and White.
1897. ULRICH, E. O. The Lower Silurian Lamellibranchiata of Minnesota. Geol. of Minn., Vol. 3, Pt. 2, pp. 475-628, pls. 35-42. Four species are reported from the rocks of the Cincinnati group in Indiana. They are *Byssonychia tenuistriata*, *Modiolopsis concentrica* Hall. & Whit., *Orthodesma canaliculatum* Ulrich, *Whitella obliquata* Ulrich.
1847. VERNEUIL, ED. DE. Note sur le parallisme des roches des depots paleozoiques de l'Amerique Septentrionale avec ceux de l'Europe, suivie d'un tableau des especes fossiles communes aux deux continents, avec l'indication des etages on elles se rencontrent, et terminee par un examen critique de chacune de ces especes. Bull. Soc. Geol. de France, (2) t. IV, pp. 640-710, 1847. Translated and condensed by Jas. Hall. Am. Jour. Sci., 2d ser., Vol. 5, 1848, pp. 176-183, 359-370; also Vol. 6, pp. 45-51, 218-231. de Verneuil considers the Black shale of Indiana and Kentucky equivalent to the Genesee of New York.
1889. VOGDES, ANTHONY W. The genera and species of North American Carboniferous Trilobites. Ann. N. Y. Acad. Sci., Vol. 4, pp. 69-105, pls. 2 and 3. Republishes the original descriptions of *Phillipsia doris* (Hall) Winch. and *P. rockfordensis* Winchell.

1881. WACHSMUTH, CHAS., AND SPRINGER, FRANK. Revision of the Paleo-Crinoidea, Part II. Proc. Phila. Acad. Nat. Sci., 1881, pp. 177-414, pls. 17-19. Describes the following new species from the Keokuk group in Indiana: *Eretmocrinus originarius*, *E. intermedius*, *E. adultus* and *Batocrinus whitei*.
1892. WACHSMUTH, CHAS., AND SPRINGER, FRANK. Description of two new genera and eight species of Camerate Crinoids from the Niagara group. Am. Geol., Vol. 10, 1892, pp. 135-144.
1878. WETHERBY, A. G. Description of a new family and genus of Lower Silurian Crustacea. Jour. Cin. Soc. Nat. Hist., Vol. I, 1878, No. 4, pp. 162-166. Describes the new Crustacean genus *Enoploura* from specimens found at Richmond and Osgood, Indiana, and Ohio localities, to which he transfers Meek's species, *balanoides*, from the Cystidae. See Meek's description in A. J. S., Vol. III (3d ser.), p. 423, 1872; also see review and sharp criticism of Wetherby's genus in Geological Magazine, May, 1880, by Dr. Henry Woodward.
1878. WHITE, C. A. Descriptions of new species of invertebrate fossils from the Carboniferous and Upper Silurian rocks of Illinois and Indiana. Proc. Phila. Acad. of Sci., 1878, pp. 29-37. The following species from Indiana are described without figures: *Baryphyllum fungulus*, *Platycrinus bonensis*, *Scaphiocrinus gibsoni*, *Lepidesthes colletti* and *Scaphiocrinus gurveyi*.
1880. WHITE, C. A. Fossils of the Indiana rocks. 2d Ann. Rep't Dept. Stat. and Geol. of Ind., 1880, pp. 471-522, pls. 1-11. A few of the more common fossils of each of the formations in Indiana are described and figured.
1883. WHITE, C. A. Fossils of the Indiana rocks, No. 3. 13th Ann. Rep't Geol. Surv. Ind., 1883, pp. 107-180, pls. 23-39. The principal species of the Coal Measures are described.
1896. WHITE, DAVID. Report on the Fossil Plants from the Hindostan whetstone beds in Orange County, Indiana. 20th Ann. Rep't Ind. Dept. Geol. and Nat. Res., 1896, pp. 354-355. Gives list of species identified from a collection of plant fossils transmitted by E. M. Kindle.
1874. WHITFIELD, R. P. 6th Ann. Rep't Geol. Surv. Ind., pp. 179-182. Gives a list of fossils from the black shale, with notes.
1881. WHITFIELD, R. P. Remarks on Dictyophyton, and descriptions of new species of allied forms from the Keokuk beds at Crawfordville, Indiana. Bull. Am. Mus. Nat. Hist., Vol. I, 1881, pp. 10-20, pls. 3, 4. Three new species are described—*Uphantenia dawsoni*, *Dictyophyton cattiliforme* and *D. cylindricum*.

1882. WHITFIELD, R. P. On the fauna of the limestones of Spergen Hill, Indiana, with a revision of the descriptions of its fossils hitherto published and illustrations of the species from the original type series. Bull. Am. Mus. Nat. Hist., Vol. I, 1882, pp. 39-97, pls. 6-9. Two new species are described from the St. Louis L's, at Spergen Hill—*Pteronites spergensis* and *Cytherellina glandella*. A list of species identified from this locality in addition to the species described by Hall is given.
1885. WHITFIELD, R. P. Notice of a new Cephalopod from the Niagara rocks of Indiana. Bull. Am. Mus. Nat. Hist., 1885, Vol. I, No. 6, p. 192, pl. 21.
1884. COPE, E. D., AND WORTMAN, J. L. Postpliocene vertebrates of Indiana. 14th Ann. Rep't Dept. Geol. and Nat. Hist. Surv.
1876. WINCHELL, N. H. Vegetable remains in the drift deposits of the Northwest. Am. Assoc. Adv. Sci. Proc., Vol. 24, Part 2, pp. 43-56, 1876.
1865. WINCHELL, ALEXANDER. Descriptions of new species of fossils from the Marshall group of Michigan and its supposed equivalents in other States; with notes on some fossils of the same age previously described. Proc. Phila. Acad. Nat. Sci., 1865, pp. 109-133. Describes and gives notes on six species of fossils from Rockford, Indiana.
1869. WINCHELL, ALEXANDER. On the geological age and equivalents of the Marshall group. Proc. Am. Phil. Soc., Vol. XI, pp. 57-83; Vol. XII, pp. 385-478. Gives a catalogue of the fossils of the Marshall group and its equivalents in the States where it has been recognized, including Indiana.
1895. WINCHELL, N. H., AND SCHUCHERT, C. Sponges Graptolites and Corals from the Lower Silurian of Minnesota. Geol. of Minn., Vol. 3, Pt. 1, pp. 55-95, pls. F. and G. Describes and figures some corals from Indiana—*Streptelasma rusticum* and *Protarea vetusta*.
1884. WORTHEN, A. H. Descriptions of two new species of Crustacea, fifty-one species of Mollusca, and three species of Crinoids from the Carboniferous formation of Illinois and adjacent States. Bull. No. 2, Ill. State Mus. Nat. Hist., 1884, pp. 1-27. The following new species from Crawfordsville are described without figures: *Sanguinolites? multistriatus*, *Aviculopecten spinuliferous*, *A. colleti* and *Batocrinus montgomeryensis*.
1889. WORTHEN, A. H. Catalogue of American Paleozoic fossils: the collection of Prof. A. H. Worthen, deceased. pp. 1-75, Warsaw, Ill., 1889. This collection, which is now the property of the State of Illinois, includes about 752 types, 240 of which are Crinoids. Many of the specimens are from Indiana.

THE
BIRDS OF INDIANA.

A DESCRIPTIVE CATALOGUE OF THE BIRDS THAT HAVE
BEEN OBSERVED WITHIN THE STATE, WITH AN
ACCOUNT OF THEIR HABITS.

By AMOS W. BUTLER.

INTRODUCTION.

At the request of Prof. W. S. Blatchley, the chief of the Department of Geology and Natural Resources, I have undertaken the preparation of a report upon the birds of Indiana. This is made necessary by the fact that Dr. A. W. Brayton's "Catalogue of the Birds of Indiana," published in 1879, has long been out of print and the supply of my own catalogue of 1890 is practically exhausted. Both of these papers were published by the Indiana Horticultural Society.

With the increasing interest in the relations of birds to the farm, orchard, garden and lawn; with the attention that has of late been directed to birds as subjects for nature study in all our schools and with the awakening desire to prevent the slaughter of native beneficial birds, for purposes of decoration and adornment, has come a demand for information relating to the birds about us that is unsupplied.

It is desired that I give at this time an account of the occurrence, distribution, breeding range, nesting habits and foods of the birds of the State, to which shall be added descriptions of all the species that occur within our limits and an artificial key to aid in their determination. With the material available, the result of over twenty-one years' observations on the migrations of birds within the State of Indiana, it was to have been hoped that the way might have opened for some extended consideration of the data at hand. I have been enabled

to illustrate slightly the movements of birds generally, giving the earliest and latest dates as indicating the two extremes of the migratory periods as they are known to us. It is to be hoped that at an early date at least one volume will appear, giving some of the more important results of the observations that have been made.

While this report is based largely upon my notes, made principally in southeastern Indiana within the past twenty-one years, I have also had the benefit of the material that has come into my hands as the curator of the Department of Ornithology of the Indiana Academy of Science. Dr. C. Hart Merriam, chief of the Biological Survey of the U. S. Department of Agriculture, has very kindly afforded me facilities for examining the migration reports in his office from Indiana for a series of years. He has also arranged to supply such cuts as are in the possession of that department for the purpose of illustrating this report.

I have been favored with the assistance of Mr. Robert Ridgway, curator of the Department of Birds of the United States National Museum; Dr. J. A. Allen, American Museum of Natural History, New York; Dr. F. W. Langdon, Mr. Charles Dury, Mr. H. W. McBride, Cincinnati, O.; Mr. Ruthven Deane, Mr. H. K. Coale, Mr. J. G. Parker, Jr., Mr. F. M. Woodruff, Chicago, Ill.; Mr. E. R. Quick, Brookville, Ind.; Mr. C. E. Aiken, Salt Lake City, Utah; Mr. Jerome Trombley, Petersburg, Mich.; Mr. L. Whitney Watkins, Manchester, Mich.; Prof. B. W. Evermann, Ichthyologist, U. S. Fish Commission, Washington, D. C.; Prof. W. S. Blatchley, Dr. A. W. Brayton and Hon. R. Wes. McBride, Indianapolis, Ind., and also of Mrs. Jane L. Hine, Sedan; Mr. E. J. Chansler, Bicknell; Messrs. L. A. and C. D. Test, Lafayette; Prof. H. S. Voorhees, Brookville, and Miss Lulu Ward, Milton, and of a great number of patient investigators who, for the love of nature and the desire to advance knowledge, have made careful observations and submitted valuable reports. Towards the end of this paper I have attempted to mention them by name, and I sincerely hope I have omitted none. To each one I extend my thanks for the assistance rendered.

In addition the J. B. Lippincott Company have kindly given me permission to make use of the keys in Ridgway's Manual of North American Birds. A. C. McClung & Company have granted the same permission regarding Dr. Jordan's Manual of Vertebrates, and Dr. Elliott Coues has authorized me to make use of his Key to North American Birds. I am indeed thankful for the courtesy extended by the persons interested in these valuable works. I have availed myself of the opportunity, and from them have gathered much

of the material for the keys and descriptions found herein. In addition I have consulted Dr. Wheaton's Birds of Ohio, Mr. McIlwraith's Birds of Ontario, Prof. Cook's Birds of Michigan, Mr. Ridgway's Birds of Illinois, Dr. Hatch's Birds of Minnesota, Dr. Warren's Birds of Pennsylvania, Mr. Chapman's Birds of Eastern North America, Maj. Bendire's Life Histories of North American Birds, Mr. Nehrling's North American Birds, the reports of Professors King and Forbes on the food of birds, and numerous other publications, from all of which I have used more or less material. For this I desire to acknowledge my indebtedness to those authors and to others to whose works reference is made herein.

It has been my purpose not to include within this list any bird which has not been ascertained to occur within the State and not to note any species as having bred unless I have been satisfied upon good authority that it has done so. I have added a supplemental list of species which, from their having been taken near our limits, may, with greater or less probability, be expected to be found within the State.

THE INDIANA BIRD LAW.

In 1891 the Legislature, at the request of the Indiana Academy of Science and the Indiana Horticultural Society, enacted the following law for the protection of our native beneficial birds:

"AN ACT for the protection of birds, their nests and eggs.

(Approved March 5, 1891.)

"Section 1. Be it enacted by the General Assembly of the State of Indiana, That it shall be unlawful for any person to kill any wild bird other than a game bird or purchase, offer for sale any such wild bird after it has been killed, or to destroy the nests or the eggs of any wild bird.

"Sec. 2. For the purpose of this act the following shall be considered game birds: the Anatidæ, commonly called swans, geese, brant, and river and sea ducks; the Rallidæ, commonly known as rails, coots, mud hens, and gallinules; the Limicolæ, commonly known as shore birds, plovers, surf birds, snipe, woodcock, and sandpipers, tattlers, and curlews; the Gallinæ, commonly known as wild turkeys, grouse, prairie chickens, quail, and pheasants, all of which are not intended to be affected by this act.

"Sec. 3. Any person violating the provisions of section 1 of this act shall, upon conviction, be fined in a sum not less than ten nor more than fifty dollars, to which may be added imprisonment for not less than five days nor more than thirty days.

"Sec. 4. Sections 1 and 2 of this act shall not apply to any person holding a permit giving the right to take birds or their nests and eggs for scientific purposes, as provided in section 5 of this act.

"Sec. 5. Permits may be granted by the Executive Board of the Indiana Academy of Science to any properly accredited person, permitting the holder thereof to collect birds, their nests or eggs for strictly scientific purposes. In order to obtain such permit the applicant for the same must present to said Board written testimonials from two well known scientific men certifying to the good character and fitness of said applicant to be entrusted with such privilege, and pay to said Board one dollar to defray the necessary expenses attending the granting of such permit, and must file with said Board a properly executed bond in the sum of two hundred dollars, signed by at least two responsible citizens of the State as sureties. The bond shall be forfeited to the State and the permit become void upon proof that the holder of such permit has killed any bird or taken the nests or eggs of any bird for any other purpose than that named in this section, and shall further be subject for each offense to the penalties provided in this act.

"Sec. 6. The permits authorized by this act shall be in force for two years only from the date of their issue and shall not be transferable.

"Sec. 7. The English or European house sparrow (*Passer domesticus*), crows, hawks, and other birds of prey are not included among the birds protected by this act.

"Sec. 8. All acts or parts of acts heretofore passed in conflict with the provisions of this act are hereby repealed.

"Sec. 9. An emergency is declared to exist for the immediate taking effect of this act, therefore the same shall be in force and effect from and after its passage."

In some localities this law has been enforced, but presumably in others it is not well known. It is to be hoped that our citizens will familiarize themselves with it to the end that it may be made efficient throughout the Commonwealth.

POSITION AND BOUNDARY.

The following is an account of the location and physical features of Indiana. The quotations are from Dr. Charles R. Dryer's "Studies in Indiana Geography:"

"Indiana is one of the North Central States, situated in what is sometimes called the Middle West, between the upper Great Lakes and the Ohio, and mostly in the Mississippi basin. The central parallel of the United States, the 39th, crosses its southern third and it is included between 37 degrees 41 minutes and 41 degrees 46 minutes north latitude, and between 84 degrees 44 minutes and 88 degrees 6 minutes west longitude. It is bounded on the north by the parallel which is ten miles north of the southern extremity of Lake Michigan; on the east by the meridian of the mouth of the Great Miami River; on the south by the Ohio, and on the west by the Wabash river and the meridian of Vincennes. Its extreme length is 250 miles, its average width 145 miles, its area 36,350 square miles.

ELEVATION.

"According to Powell's division of the United States into physiographic regions, Indiana lies mostly on the Ice Plains, but includes a small portion of the Lake Plains on the north and of the Alleghany Plateau on the southeast. The highest land in the State, in southern Randolph county, is 1,285 feet above tide; the lowest, at the southwest corner is 313 feet. The area above 1,000 feet comprises 2,850 square miles, in three tracts: (1) An irregular area around the headwaters of the Whitewater river, in Union, Wayne, Randolph, Delaware, Henry, Rush, Decatur, Franklin and Ripley counties;* (2) a narrow crescentic ridge in Brown county; (3) a considerable area in Steuben, DeKalb, Noble and Lagrange counties. Isolated peaks rise in Brown county to 1,172 feet and in Steuben to 1,200 feet. The area between 500 and 1,000 feet in elevation is 28,800 square miles and that below 500 feet is 4,700 square miles. The average elevation of the state is 700 feet.

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PHYSIOGRAPHIC REGIONS.

"The most striking physical contrast in Indiana is that between the glaciated and unglaciated areas. A comparison of the topographic map with that showing the revised glacial boundary brings out this contrast sharply. North of the limit of drift the contour lines run in large curves and are far apart, showing the general smoothness and monotony of the surface. South of the glacial boundary the lines are crowded and extremely tortuous, showing a surface much cut up. The limit of drift incloses and fits this area of broken surface as a man's coat fits his shoulders.

"*The Ohio Slope.*—That portion of the State which slopes directly to the Ohio, including the driftless area and the southeastern part of the drift plain, is a region of deep, narrow valleys, bounded by precipitous bluffs and separated by sharp, irregular divides. Isolated knobs and buttes are numerous; the crests and summits are from 300 to 500 feet above the valley bottoms. The streams are rapid and broken by frequent cataracts. All open out into the Ohio Valley, a trench from one to six miles wide, 400 feet deep and bounded by steep bluffs.

"*The Central Plain.*—North of an irregular line extending in a general direction from Richmond to Terre Haute, and south of the westward flowing portion of the Wabash from Fort Wayne to Attica,

* Also Fayette and a part of Dearborn.

the topography is that of an almost featureless drift plain. It is traversed by numerous morainic ridges, but they are low and inconspicuous. The traveler may ride upon the railway train for hours without seeing a greater elevation than a hay stack or a pile of sawdust. The divides are flat and sometimes swampy, the streams muddy and sluggish. The valleys begin on the uplands as scarcely perceptible grooves in the compact boulder clay, widen much more rapidly than they deepen and seldom reach down to the rock floor.

"The Northern Plain.—The portion of the drift plain north of the Wabash river is more varied than the central plain, and comprises several regions which differ materially in character. A small area around the head of Lake Michigan is occupied by sand ridges and dunes, partly due to a former extension of the lake and partly to present wind action. Some of the drifting dunes are more than 100 feet high. This region is separated by a belt of morainic hills from the *basin of the Kankakee*, which contains the most extensive marshes and prairies in the State. This region also is traversed by numerous low ridges of sand, the origin and character of which are not yet well understood. Many of its features are probably due to the fact that during the retreat of the ice-sheet it was temporarily occupied by a glacial lake, which received the wash from the high moraines to the eastward. Northeastern Indiana is the *region of high moraines*, and has a strongly marked character of its own. A massive ridge of drift, 25 miles wide, 100 miles long and from 200 to 500 feet thick, extends from Steuben County to Cass County and is joined by several smaller branches from the northwest. This is the joint moraine of the Erie and Saginaw lobes of the Laurentide glacier. Much of its surface is extremely irregular, presenting a succession of rounded domes, conical peaks, and winding ridges, with hollows of corresponding shape between, which are occupied by innumerable lakes and marshes; the highest points are 100 to 300 feet above the level intermorainic intervals. A large proportion of the material is sand and gravel. A small area in eastern Allen County is a part of the bed of the glacial Lake Maumee.

DRAINAGE.

"The general slope of Indiana is to the southwest, as indicated by the course of the Wabash River and its tributaries, which drain two-thirds of the State. Of the remaining third one-half is drained directly to the Ohio and one-half to Lakes Erie and Michigan and to the Mississippi through the Illinois.

"*The Wabash River* is the great artery of Indiana, which it traverses for more than 400 miles. The fall is quite uniformly about eighteen inches per mile. Its current is gentle and unbroken by notable rapids or falls. Its valley is quite varied in character. Above Huntington it is a young valley, without bluffs, terraces or flood plain. Below Huntington it once carried the drainage of the upper Maumee Basin, and is nowhere less than a mile wide as far down as Attica. Below that point its width varies from two to six miles. The original valley has been largely filled with drift, which the present river has been unable to clear out. It winds between extensive terraces of gravel, which border it at various elevations, and flows at a level from 50 to 100 feet above the original rock floor. Below Terre Haute, the wide flood plain, ox-bow bends and bayous give it a character similar to that of the lower Mississippi. The upper tributaries as far down as Lafayette are post-glacial streams in drift valleys, whose courses are largely determined by the trend of the moraines. Below that point the smaller tributaries enter the river through picturesque sandstone gorges.

"*White River*, the largest tributary of the Wabash, and rivaling it in volume of discharge, is a much more varied and complex stream. The larger West Fork rises at the summit level of the state in Randolph county. In its upper course it is moraine-guided, like the upper tributaries of the Wabash, and presents the same characters as the other streams of the central plain. In Morgan county it assumes a different aspect, and thence to its mouth flows through a valley from one to three miles wide, 100 to 300 feet deep, bordered by wide bottoms. The East Fork rises on the same elevation as the West, but reaches its destination by a more tortuous course. Although its length is increased and its slope decreased by its numerous meanders, it is still a swift stream. Both forks of White river suffered many disturbances during the glacial period, which have not yet been studied in detail, but are obvious from the varying character of their valleys and from the terraces which border them at all heights up to 300 feet.

"*The Whitewater River* takes the shortest course of all from the summit level to the Ohio, and its average fall is about seven feet to the mile. At Richmond it has cut a narrow gorge into the soft shales 100 feet deep. In strongest contrast with this and the other rivers of the Ohio Slope is the *Kankakee*, which winds through wide marshes with a scarcely perceptible current and without definite banks. Its basin, however, is sufficiently elevated to render good drainage possible by the construction of the requisite ditches, and much has already been done to that end.

PHYSIOGRAPHIC FEATURES.

"Many important land forms are wanting in Indiana. There are no mountains, no valleys formed by upheaval or subsidence, no volcanoes or volcanic rocks except foreign fragments brought by the ice sheet, no features due to disturbance of the earth crust except the rock foundations of the State itself.

"*Plains*.—As already indicated, the greater part of Indiana is a *plain of accumulation*; the surface of a sheet of glacial drift which varies in thickness from a few feet to 500 feet or more. The average thickness is more than 100 feet. It consists chiefly of a mass of clay containing more or less gravel and boulders—the *till* or boulder clay of the geologists. This is locally varied by heaps, ridges, sheets and pockets of sand and gravel, and in the southern part of the State is overlain by a peculiar fine silt called *loess*. The boulder clay is the grist of the glacial mill, and is composed of a very intimate and heterogeneous mixture of native and foreign materials, containing fragments of almost every known mineral and rock. The large fragments, or boulders, are widely distributed, and of every size up to 30 feet in diameter. They are nearly all igneous or metamorphic in character and can be traced back to their origin in the Canadian highlands north of the Great Lakes.

"The driftless area is a *plain of degradation*, formed by the removal of the original rock surface to an unknown depth, and now represented by the summits of the flat and even-topped divides, ridges and hills.

"*Hills*.—On the northern plain occur numerous *hills of accumulation* forming the great morainic belts, the result of excessive dumping and heaping up of drift along the margins and between the lobes of the melting ice-sheet. The most impressive examples are found in Steuben, Lagrange, Noble and Kosciusko counties, where they attain a height of 200 feet or more, and are as steep and sharp as the materials will lie. Their peculiar forms and tumultuous arrangement give a striking and picturesque character to the landscape.

"The Ohio Slope is studded all over with *hills of degradation*—blocks and fragments of the original plain left by the cutting out of the valleys between them. Some are broad and flat-topped, some narrow, crooked and level-crested, some sharp or rounded, isolated knobs or buttes. These are very conspicuous in the counties of Greene, Daviess, Martin, Crawford, Orange, Washington and Jackson, but attain their greatest development in Floyd, Clark and Scott, where the Silver Hills and Guinea Hills rise to 400 and 500 feet above the valley

bottoms. In Brown County the knob topography attains the highest absolute elevation in Weed Patch Hill, and the surrounding region is so rugged as to have gained the title of the 'Switzerland of Indiana.'

"In Benton county Mounts Nebo and Gilboa are isolated masses of rock projecting above the general level of the plain, and are probably entitled to the name of *monadnocks*.

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"*Lakes*.—The surface of the northern plain is peppered with small lakes which occupy irregular depressions in the surface of the drift, and are especially characteristic of the massive moraines. The whole number cannot be less than 1,000. The largest, Turkey Lake in Kosciusko county, has an area of five and a half square miles.

"*Marshes and Swamps*.—These exceed the lakes in number and extent. The smaller ones are the basins of former lakes which have been filled up with sediment and vegetation. The largest are in the Kankakee Basin, and are the remaining vestiges of a glacial lake. Everywhere over the central plain the divides are too flat and the slopes too gentle for good drainage, and marshes abound. These, however, have been largely drained by ditches."

The surface of the State presents considerable differences in its vegetation. The heaviest timber which was found in central and southern Indiana has for the greater part disappeared. Throughout the northern part of the State the number of large trees is much less and the general size of forest trees decreases noticeably as one proceeds northward.

"Contrary to the statements made in many books, Indiana is not a prairie state. An area estimated to comprise one-eighth of the whole, situated, except a few isolated patches in the northwestern part, is marsh and upland prairie. The remainder of the State was originally covered by a heavy growth of oak, walnut, beech, maple and other hardwood timber, with sycamore and poplar near the streams and a little pine along the Ohio slope. No region in the United States could show finer specimens or a greater number of individuals and species of forest trees than the lower Wabash Valley. The same region is said to be the original habitat of the bluegrass which has made Indiana and Kentucky pastures so famous." (Dryer, p. 25.)

PECULIARITIES AFFECTING BIRD DISTRIBUTION.

The region about the southern end of Lake Michigan presents an unusually fertile field for the ornithologist. Situated as it is, midway between the wooded region of the East and the treeless plains of the West, with the warm river bottoms of the South, rich in southern species, extending to within a comparatively short distance, and the great lake upon the north, northwestern Indiana forms a kind of "four corners" where the avian faunæ of four regions intergrade. To the proximity of Lake Michigan we are indebted for a number of more or less strictly maritime species. As would be expected the southern species occur only in summer, with the exception of *Lophophanes bicolor*, which is found only in winter. Not only is the influence of the lake upon the faunæ shown by the occurrence of numerous species of birds, attracted by the presence of a large body of water, with its congenial surroundings, but the influence of the lake upon the climate and the vegetation in its immediate vicinity has a marked influence upon the list of summer residents. The northwestern portion of the State is divided into alternating tracts of prairie, marsh and woodland, each possessing a bird life of its own. In Lake County, along the Lake Shore, is a stretch of pine woods known as "the pinery," which is quite peculiar. (Condensed from E. W. Nelson's notes of "Birds of Northeastern Illinois.") Coming south one crosses the Kankakee River and marshes, well-known regions for water fowl and marsh-inhabiting birds, and enters the Wabash Valley. Back from this valley proper we find occasional prairies and extensive meadows, where such prairie-inhabiting forms as Henslow's Sparrows, Yellow-winged Sparrows, Black-throated Buntings and Prairie Larks are expected to be found. The lower Wabash Valley is noted for its extended "bottom lands" and "cypress swamps," which, for their flora no less than their birds, are of much interest. The amount of bird life here in summer is very much in excess of that in the northwestern corner of the State at that season. The difference in the number of birds noted would be readily observed. In the southeastern part of the State the land rises in some places almost 400 feet above the Ohio River within a mile or very little more. On leaving the fertile river bottoms, with their successive terraces, one ascends the steep river hills and soon reaches the wet flats where the drainage is so poor that the water stands upon the surface beneath the oak and beech timber the greater part of the year. There is an intimate relation between the topography and the character of the soil here. There is a

comparatively level plateau extending from the Ohio River "bluffs" to the northward, west of the valley of the Whitewater, and forming the water shed of a number of streams, some running into the Whitewater and some into the White River. This surface soil is usually a white or gray clay, characteristic of the country within 30 miles of the Ohio River in the southeastern corner of the State. From this one descends until the "broken uplands" are found lying just below the level land. Still lower down the "hillsides" are reached. These rise more or less abruptly from the bottom lands. The prevailing timber of this region is oak, maple, beech, sweet gum, black gum, etc., and with them are found, each in its season, some birds which prefer these surroundings—Summer Redbird, Cape May Warbler, Black-throated Blue Warbler, etc. East of the Whitewater River to beyond the Ohio line the country is more level and the soil darker and more fertile, the land ranking with the best in the State. The central portion of the State is comparatively level and very fertile. It was more recently settled than the southeastern portion, and hence to-day there may still be seen among the finest farms specimens of the largest trees to be found upon Indiana soil. The northeastern part of the State has been but little explored by the zoologist. Doubtless it will prove a valuable field for the one who will occupy it. This is the "lake region" of Indiana. Within this quarter is the meeting of two drainage systems—the Wabash to the southwest and the St. Joseph and St. Mary's to the northeast. The Wabash River is the line of principal migration in Indiana. As it turns to the eastward many routes leave it for the north, particularly just south of Lake Michigan, but many birds follow its course along its length. To this fact seems to be due the peculiar distribution of such forms as the Prothonotary and Cerulean Warblers, and in less degree the Kentucky, Worm-eating and Sycamore Warblers.

CHANGES IN BIRD-LIFE.

When our race first viewed this region it was a vast forest, a wilderness, unbroken save by the water courses, the trail of the Indian, the runways of the deer, the roadways of the buffalo. Our birds were only such as frequented the densest woodland or the bars in the river channels, together with forms of wide range and birds of passage. With the cutting away of the larger trees sprang up thickets, and therewith came thicket-inhabiting forms. As the clearings were extended meadow lands and pasture lands were reserved. To the meadows came such forms as the Bay-winged Bunting, Field Sparrow, Black-throated Bunting and Grasshopper Sparrow, species peculiar to such surroundings. Some parts of this land were wet and, where the drainage was

not good, became swamps and sloughs. There birds peculiar to such localities settled, among them Marsh Wrens, Rails, Gallinules, Swamp Sparrows and Red-winged Blackbirds. As the orchard and garden developed, other birds, well known to us and greatly beloved for their cheery, social ways, there made their home; such are the Orchard Oriole, Warbling Vireo and Yellow Warbler. The changes in conditions and continual increase in number of settlers caused a continual diminution in numbers of many birds; especially is this true of geese, ducks and other water-loving species, while some birds famous in history and literature have passed from us and are fast becoming extinct. Such are the Ivory-billed Woodpecker, Pileated Woodpecker, Wild Turkey and Carolina Parakeet. About our homes the Bluebirds, House Wrens and Carolina Wrens came and lived with us, even nearer and dearer than other birds.

As time went on drainage became a feature introduced into the new country. With the drainage of our sloughs and swamps a second change was noted. The forms of avian life, which lived among its reeds and flags, mingling their voices with those of the frogs, disappeared, and the land reclaimed tells, in its luxuriant growth of corn, no story to the casual passer-by of the former population which occupied it. Time went on, change followed change, little by little, but still each cleared field, each rotation of crops, each one of a thousand variations in cause had its effect upon the numbers or the life history of our birds.

DESTRUCTION OF BIRDS.

By man's agency the English Sparrow was introduced, and as its numbers increased, began to assert itself in the struggle for existence. The Bluebird, which has come from the hole in the snag, was driven from her box. The Martin and Chimney Swift, which formerly nested in hollow trees, left their nesting sites about the house, and even the Eave Swallow, which in olden times fastened its nests to the cliffs, was in some cases driven away. The warfare still continues with this aggressive little foreigner, worse some places than others, but with such surprising powers of reproduction and unheard-of audacity, it seems they must soon cover our entire continent.

Another epoch in this category is marked by the abnormal craze which has for some years been noted of using the skins and parts of birds for purposes of decoration and adornment. This barbarous custom has been frowned down in some places by society leaders, but is still quite common.

It is marvelous, the destruction of innocent, beneficial lives that have been sacrificed upon the altar of fashion. Our State has now a very good law for the protection of our native birds, and it behooves us all to see that in our communities, our separate neighborhoods, that law is fully enforced. Unless this is done we may awake too late to the importance of protecting these feathered friends who gather their substance from the insect enemies of the farm, the orchard, the garden and the woodland.

Birds are also destroyed in great numbers by natural causes. The sudden severe storms which occur at times in the migrating season often cause the death of a great number of tiny wanderers. It is no unusual thing to find along the shores of Lake Michigan, and numbers of other great lakes, following some severe, cold storm, the bodies of great numbers of migrating birds. How great this loss of life is cannot be estimated, but they are often found lying close together on the beach where they have been tossed by the waves. Again, it is no unusual thing to find, following a spell of cold weather in April or May, the bodies of many birds which have just arrived from the South and have been unable to withstand the effects of the sudden cold which came upon them. Other birds which irregularly winter with us, at times when they attempt to remain, are destroyed in great numbers in unusually severe and unfavorable winter weather. A striking illustration of this was the severe weather of the late winter and early spring of 1895, when, over almost the entire Southern States east of the Mississippi, a cold wave prevailed coincident with the winter range of the Bluebirds, Hermit Thrushes, Robins and other birds occupying that region. These wintering birds were destroyed in great numbers—so great, in fact, as almost to exterminate the entire race of Bluebirds and to greatly lessen the numbers of some other forms. In addition to this, many birds are destroyed at the time of migration on dark nights by flying against the lighthouses, light towers and other lights in high places. Unfavorable weather during the breeding season is also the cause of large loss of life among the young birds and of the destruction of many eggs.

In addition, birds are subject to disease, fall a prey to their enemies, are killed by accident, and, as these conditions combine in a favorable or in an unfavorable way, we may note among many species, taking one year with another, an increase or a decrease in their normal numbers.

ZOOLOGICAL AREAS.

Geographers have attempted to divide the world into zoological regions in accordance with the harmonic distribution of certain typical forms. These zoological areas have not been very accurately defined. They may be termed the different divisions of the sea of animal life, with its tides, currents, varying temperature and depth, two areas meeting as land and sea, each with irregular shore lines and deeply indented coasts, the boundaries continually changing as barriers in one direction are overcome, and in another a different coast configuration appears.

Indiana is included entirely within the Eastern (Atlantic) faunal province, and while it is within the limits of the Carolina fauna of Mr. Allen, the southern portion contains so many birds that are distinctive of the Louisiana fauna (Austroriparian Province of Professor Cope) that it has been thought it should be referred to that district. According to Dr. Merriam's provincial classification, almost all of Indiana is included within the upper Sonoran Zone. The Transition Zone appears in the northern part, while the extreme southwestern portion is included in an arm of the lower Sonoran Zone.

BIRD MIGRATION.

The migratory instinct is one of the wonders of nature. The origin of migration seems to reach far back into the unwritten history of the past. According to geological testimony, in the earlier ages of the earth's history a warm climate existed almost to the North Pole. Then neither lack of food nor the consequences of rigorous winter compelled the birds to leave that favored region. With the changing of conditions by which the circumpolar area became colder, then ice-locked and finally the limit of ice extended far to the southward, the birds were forced to more congenial lands. With the winter they sought warmer climes, and as the summer approached they sought to return to the ancestral home. Finally the southern limit of the ice sheet was reached, and it began to recede. With its recession the birds were enabled to reach higher latitudes, and in time, when the frigid area reached its present limitation, there was left for our solution the problem of the migration of birds. This habit is not the acquirement of any one bird, but is the influence of the experience of many generations of birds extending through long ages of time, an inherited desire to seek nesting sites near the old home of their race.

With what regularity do certain forms leave their summer homes in the temperate and frigid realms and traverse the great expanse of plain and wood and ocean to far within the tropics, there spending the

colder parts of the year, returning to the same breeding ground when summer approaches. Undoubtedly they pursue long lines of migration, as though following beaten paths, for thousands of miles. Over river and lake and sea, over marsh and mountain and meadow they fly. So accurate is the chart, so true the compass of instinct, that each returning annual pilgrimage brings the little wanderers to their former homes. When the frosts touch the maple leaves and tinge the woods with bright autumn colors we miss some of our little friends. Day after day as the daylight grows shorter others follow where they led, until, when the snows come, many of the summer songsters have left us. These have sought the regions best suited to their condition in winter, where the food supply is more abundant or more easily obtained. Others from farther north have taken their places. These, to us, are winter residents. To our friends farther northward they are summer residents; between us there is a region where they are known as migrants. Among these latter birds which spend a part or the whole winter in our States are the Junco or Black Snow-bird, one form of Shore-lark, Tree Sparrows, the Sapsucker or Yellow-bellied Woodpecker, rarely the White Snow-bird or Snowflake, the Snowy Owl and the Bohemian Waxwing. Their summer homes are north of us.

Some of the forms, perhaps most of them, which are with us the whole year round are not represented winter, spring, summer and autumn by the same individuals. In winter the Song Sparrow among the garden shrubbery or in the willow thickets are not particularly numerous, but late in March and early in April a host of Song Sparrows have appeared from the milder climate of Tennessee and neighboring States. Their numbers are very noticeable, but they, with many, perhaps all, of those who wintered with us, have passed on farther north. The usual number remains to keep house, rear a family and cheer humanity with their songs. With October those who spent their summers farther north return, and, as the frosts succeed dews and snows succeed frosts, they gradually pass by to favorite winter homes, leaving the individuals we knew the past winter with their children, our companions through the colder part of the year. The American Goldfinch that appears with the apple leaves in April in lemon-yellow dress with black cap and wings, comes from the southland to replace other more hardy relatives of his by the same name, who were hardly recognized by many of us for the plain winter dress they wore. Well, they passed on northward just a day or two before these brighter-appearing ones arrived from the pine groves and cotton fields of the Southern States. Next fall they will return with their bright colors deadened by the touch of the north wind, but we will know them by their voices.

The impression which may prevail that the winter residents are smaller than the summer forms is erroneous. The Shore-larks, which winter with us, represent the same species which is resident in summer and the northern form which is larger. The idea that many birds migrate at night is correct.

Some winters the Robins, Meadow Larks, Kingfishers, Killdeers, Red-headed Woodpeckers and Chewinks remain with us. Other years they pass to the southward. Even when they are here, some years they seem to the casual observer to have left; yet the inquisitive lover of birds knows his little friends are to be found, even in inclement weather, though they do not appear to the uninitiated. To such an one a protected thicket, a deep ravine, an unexposed hillside, a dense woodland, as his tramp leads through such out-of-the-way places, is found to be inhabited by forms which have disappeared to many eyes. The instinct which calls upon some to seek the better feeding grounds, the warmer places of earth, has impelled these to well-protected spots and localities where food may be most easily obtained.

The Catbird, Blackbird, Chipping Sparrow and Phoebe go but a little farther south, some years lingering along the Ohio River.

The Marsh Wrens, Red-winged Blackbird, Hermit Thrush and sometimes the beautiful little Ruby-crowned Kinglet and eccentric little Blue-gray Gnat-catcher linger along the gulf coast, while all the north is snow-bound.

Other birds go farther on their winter journey. The Baltimore Orioles go as far as Panama. Our cheery Bobolink with "his Quaker wife," both plain clad when cold comes nigh, visit the West Indies and South America. The King Bird reaches the West Indies and Bolivia. The Night Hawk covers the same islands and Eastern South America. The Cerulean Warbler, on the contrary, visits Cuba and Central America. Kirtland's rare warbler winters only in the Bahamas. The little Spotted Sandpiper visits Brazil. The Blue-winged Teal extends its journey to Ecuador, and Swainson's Thrush to Peru.

Some make more extended tours even than these. The American Golden Plover, a well-known game bird, which breeds in the northern part of our continent, when winter holds the northern hemisphere in his cold grasp, is found as far away as Patagonia, while the Knot, a coast bird which breeds in very high northern latitudes, the eggs of which were taken by the members of the Greely Arctic expedition at Ft. Conger, about north latitude 82 degrees, ranges to Cape Horn during our winter. Thus it will be observed migration may mean the trip to the protected thicket in the vicinity of wild grapes, blackberries and weed patches laden with seed

at the southern edge of the farm, or the almost endless voyage of some shore birds across every one of the earth's zones. It may mean a change of individuals; a moving of those which summer with us a little farther south and a filling of their places by others of the same kind from a little farther north. It may mean a restlessness which some years impels the Bob White to move southward a few miles, or again to leave the hills and congregate in the valleys, or the reverse. Many times they fly into towns, and becoming confused, enter houses and stores, and are readily caught in the hand. It may mean the slow movement of the short-winged warblers and wrens, or the rapid flight of the swallow and Wild Pigeon. Its cause is the instinct which tells them to prepare for winter or return for spring. A call that must be answered, an inherent demand that comes to each individual through the accumulated experiences of the past which it cannot disobey.

Birds do not move promiscuously over the country, but are observed to have migratory routes. The Mississippi River is a great artery along which in spring courses a mighty stream of avian life destined to its breeding ground. At the mouth of the Ohio a large stream turns off to ascend that river, sending out branches of considerable size up the Wabash, Whitewater and Miami rivers. The Whitewater Valley forms one channel by which these wandering birds reach the Maumee and the lakes, whence many pass on still farther northward to their summer homes. As the rivers become the channels of migration for certain species, other forms of different habits follow the higher lands or the mountain bases, along characteristic topographical features. As the warm air of spring comes, as from the throbbing of a great tropical heart, so the birds come, in pulsating movements, each succeeding one stronger and driving its tide of life farther along its course. Each bird-wave seems to move as though the rear of the migrating forms was continually passing over the more advanced and taking the lead. Among the smaller streams, the main ridges, the connecting woodland, at the height of the migration may readily be observed the smaller currents of bird life given off by the larger streams, each following its own course, all instinctively going in a definite direction—north. The whole movement may be compared to the circulation of sap in a tree. From trunk to limb, from limb to branch, from branch to bough, from bough to twig, from twig to leaf. The entire movement over either hemisphere may be likened to numberless trees with their roots at the equator, their topmost branches approaching the poles. In autumn the courses of the bird currents are not so plainly marked, but yet along the borders of our streams may be seen, at favorable times, hordes of little wanderers moving past in almost endless streams at early morn and eventide.

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EXPLANATION.

The nomenclature used is that adopted by the American Ornithologists' Union.

The first number given before each species is the serial number for this list; the second number, enclosed in parenthesis, is that by which it is indicated in the A. O. U. Check List.

No species is included in this list unless it is known to have been reported, upon good authority, to have been observed within the State, and no species has been reported as having bred within the State unless it is known, according to the same authority, to have done so.

All measurements are given in inches and hundredths of an inch.

KEY TO BIRDS.

ORDERS.

a¹. Hind toe well developed, all four toes connected by webs.

STEGANOPODES. C

a². Hind toe, if present, not connected with the others.

b¹. Nostrils opening through tubes. (Extralimal).

TUBINARES.

b². Nostrils not opening through tubes.

c¹. Cutting edges of bill more or less distinctly fringed, notched or toothed.

d¹. Legs short or slightly lengthened; bill not abruptly bent downward from the middle.

ANSERES. D

d². Legs excessively lengthened; bill bent abruptly downward from the middle. (Extralimal.)

ODONTOGLOSSAE.

c². Cutting edges of bill not fringed, notched, or toothed.

e¹. Legs inserted far behind the middle of the body, which, in standing position, is more or less erect; the toes webbed or conspicuously lobed.

PYGOPODES. A

e². Legs inserted near the middle of the body, which, in standing position, is nearly horizontal, or else toes not webbed.

f¹. Anterior toes distinctly webbed, tarsus shorter than tail.

LONGIPENNES. B

f². Anterior toes not distinctly webbed (with rare exceptions); toes not webbed, or webbed at base or on sides (full webbed only in a few waders with very long tarsus and the tibia partly naked).

g¹. Tarsus more or less elongate; tibia more or less naked below.

Waders.

h¹. Hind toe well developed, inserted at same level with the anterior toes; the claws never excessively lengthened; the space between the eye and the bill or the space around the eye, or both (sometimes the whole head), naked.

HERODIONES. E

h². Hind toe, if present, small and inserted above the level of the rest (or else size small or medium, length less than 3/8 inches); the space between the bill and the eye or the space around the eye fully feathered; no comb-like teeth on inner edge of middle claw.

i¹. Length over three feet.

j¹. Hind toe short and elevated.

PALUDICOLAE. F

i². Length under three feet.

k¹. Hind toe almost on level with other toes.

PALUDICOLAE. F

k². Hind toe, if present, short and elevated, or else claws excessively lengthened and wings spurred.

LIMICOLAE. G

*g*². Tarsus not greatly elongate; tibia mostly entirely feathered. Not Waders.

*l*¹. Bill strongly hooked, with distinct cere at base.

*m*¹. Toes three in front, one behind. The outer toe sometimes reversible. RAPTORES. J

*m*². Toes two in front, two behind. PSITTACI. K

*l*². Bill not both strongly hooked and cered.

*n*¹. Hind toe short, decidedly elevated; "toes slightly connected at base by web;" no soft membrane about nostrils. GALLINÆ. H

*n*². Hind toe little, if at all, above the level of the rest (rarely absent).

*o*¹. Nostrils opening beneath a soft, swollen cere; hind claw short. COLUMBÆ. I

*o*². Nostrils not opening beneath a soft, swollen cere.

*p*¹. Wings very long, with ten quills; tail of ten feathers; gape very wide and deeply cleft, or else the bill long and slender; (tongue extensile); secondaries only six in number.

MACROCHIRES. N

*p*². Wing not very long; gape not very wide nor deeply cleft; or else wing with only nine quills and tail with twelve feathers.

*q*¹. Toes only two in front; or, if three, the middle and outer toes connected for at least half their length.

*r*¹. Tail feathers stiff and pointed; bill more or less chisel-like. PICI. M

*r*². Tail feathers neither stiff nor pointed; bill not chisel-like. COCCYGES. L

*q*². Toes three in front, one behind, the middle and outer toes not united for half their length; lower part of thighs feathered and the tarsus equal to or longer than the lateral toes. PASSERES. O

FAMILIES.

A. ORDER PYGPODES.

DIVING BIRDS.

*a*¹. Feet lobate.

PODICIPIDÆ.—GREBES. I

*a*². Feet webbed.

*b*¹. With four toes.

URINATORIDÆ.—LOONS. II

*b*². With three toes.

ALCIDÆ.—AUKS, ETC. III

B. ORDER LONGIPENNES.

LONG-WINGED SWIMMERS.

- a¹. Covering of upper mandible of three distinct pieces; a terminal hook, a lateral piece, and a cere-like piece overhanging the nostrils.

STERCORARIIDÆ.—JAEGERES, ETC. IV

- a². Covering of upper mandible of a single piece pierced by the nostrils.

LARIDÆ.—GULLS AND TERNS. V

[Included in this order are the Rhynchopidæ or Skimmers, the limits of whose range do not reach this State. The above key is not intended to include them.]

C. ORDER STEGANOPODES.

DARTERS, PELICANS, CORMORANTS.

- a¹. Upper mandible hooked at tip.

- b¹. Tarsus moderate, much longer than hind toe with claw.

- c¹. Bill shorter than middle toe, compressed; gular sack small.

PHALACROCORACIDÆ.—CORMORANTS. VII

- c². Bill much longer than middle toe, much flattened; gular sack very large.

PELECANIDÆ.—PELICANS. VIII

- b². Tarsus very short, not longer than hind toe with claw; wings and tail excessively long, the latter deeply forked.

FREGATIDÆ.—MAN-O'-WAR BIRDS. IX

- a². Upper manible not hooked at tip. Bill slender, nearly straight; tail long, feathers very broad; neck very long and slender.

ANHINGIDÆ.—DARTERS. VI

D. ORDER ANSERES.

DUCKS, GEESE AND SWANS.

Characteristics the same as the order.

ANATIDÆ.—DUCKS, ETC. X

E. ORDER HERODIONES.

HERONS, STORKS, IBISES, ETC.

- a¹. Sides of upper mandible with a deep, narrow groove extending from the nostrils to the tip.

- b¹. Bill very broad, much flattened, and greatly widened toward the tip, only the end bent down.

PLATALEIDÆ.—SPOONBILLS. XI

- b². Bill slender, nearly round, gradually bent downward for nearly its whole length.

IBIDIDÆ.—IBISES. XII

- a². Sides of upper mandible without groove.

- c¹. Middle toe nail with comb-like inner edge; claws narrow, arched, and sharp pointed.

ARDEIDÆ.—HERONS, ETC. XIV

- c². Middle toe nail with comb-like edge; claws broad and flat, resting on a horny pad or shoe.

CICONIIDÆ.—STORKS, ETC. XIII

F. ORDER PALUDICOLÆ.

THE SWAMP BIRDS—CRANES, RAILS, COOTS, ETC.

- α^1 . Size large; wing over 10 inches; bill over 3 inches. GRUIDÆ.—CRANES. XV
 α^2 . Size small; wing under 10 inches; bill under 3 inches.

RALLIDÆ.—RAILS, ETC. XVI

G. ORDER LIMICOLÆ.

THE SHORE BIRDS—SNIPES, PLOVERS, SANDPIPERS, ETC.

- α^1 . Toes with lobed webs on the sides; tarsus compressed.
 PHALAROPODIDÆ.—PHALAROPES. XVII
 α^2 . Toes without lobed webs on the sides; tarsus not extremely compressed.
 b^1 . Tarsus more than twice the length of middle toe with claw.
 RECURVINOSTRIDÆ.—AVOCETS, ETC. XVIII
 b^2 . Tarsus less than twice the length of middle toe with claw.
 c^1 . Front of tarsus covered with a continuous row of transverse, four-sided scales. Toes four (except Sanderling).
 d^1 . Bill slender with blunt tip, soft skinned and sensitive throughout.
 SCOLOPACIDÆ.—SNIPE, ETC. XIX
 c^2 . Front of tarsus covered with small six-sided or irregular scales; toes three (except Black-bellied Plover). CHARADRIIDÆ.—PLOVERS. XXI
 d^2 . Bill stout, hard, pointed and wedge shaped at the tip in our species.
 APHRIZIDÆ.—SURF BIRDS, ETC. XX

H. ORDER GALLINÆ.

PHEASANTS, GROUSE, PARTRIDGES, ETC.

- α^1 . Tarsus with spurs in male; head naked or tail long and vaulted.
 PHASIANIDÆ.—PHEASANTS, ETC. XXIII
 α^2 . Tarsus without spurs; head feathered (or nearly so); tail not vaulted.
 TETRAONIDÆ.—GROUSE, ETC. XXII

I. ORDER COLUMBÆ.

THE PIGEONS.

- Characters same as the order. COLUMBIDÆ.—PIGEONS. XXIV

J. ORDER RAPTORES.

BIRDS OF PREY.

- α^1 . Head entirely naked (downy in young); feet not adapted for grasping; nostril longitudinal.
 CATHARTIDÆ.—AMERICAN VULTURES. XXV
 α^2 . Head nearly or fully feathered; feet especially adapted for grasping; nostrils vertical or roundish.

*b*¹. Eyes lateral, not surrounded by discs of radiating feathers; cere exposed.

FALCONIDÆ.—FALCONS. XXVI

*b*⁴. Eyes set in front, surrounded by discs of radiating feathers; cere covered.

*c*¹. Middle claw having comb-like edge. STRIGIDÆ.—BARN OWLS. XXVII

*c*². Middle claw not having comb-like edge.

BUBONIDÆ. HORNED OWLS; SCREECH OWLS, ETC. XXVIII

K. ORDER PSITTACI.

PARROTS, PAROQUETS, ETC.

Characters the same as the order.

PSITTACIDÆ.—PARROTS, PAROQUETS, ETC. XXIX

L. ORDER COCCYGES.

CUCKOOS AND KINGFISHERS.

*a*¹. Toes two in front, two behind; bill as long as head, curved downwards.

CUCULIDÆ.—CUCKOOS. XXX

*a*². Toes three in front, one behind; outer and middle toes united for half their length; bill straight, longer than head.

ALCEDINIDÆ.—KINGFISHERS. XXXI

M. ORDER PICI.

WOODPECKERS.

Characters the same as the order.

PICIDÆ.—WOODPECKERS. XXXII

N. ORDER MACROCHIRES.

WHIP-POOR-WILLS, SWIFTS, HUMMINGBIRDS, ETC.

*a*¹. Bill short, broad at base; mouth deeply cleft; plumage not metallic.

*b*¹. Middle toe much the longest, its claw with comb-like edge; gape bristled; plumage spotted. CAPRIMULGIDÆ.—WHIP-POOR-WILLS, ETC. XXXIII

*b*². Middle toe not much, if any, longer than others, its claw without comb-like edge; gape without bristles; plumage black.

MICROPODIDÆ.—SWIFTS. XXXIV

*a*². Bill very long and slender; mouth not deeply cleft; plumage more or less metallic; size small.

TROCHILIDÆ. HUMMINGBIRDS. XXXV

O. ORDER PASSERES.

*a*¹. Tarsus with its hinder edge rounded.

*b*¹. Inner toe free at base from middle toe; bill hooked at tip, with bristles at base; primaries ten, the first about as long as second.

TYRANNIDÆ.—FLYCATCHERS. XXXVI

b². Bill not hooked at tip, no bristles at base; developed primaries nine; hind toe with long, nearly straight claw. ALAUDIDÆ.—LARKS. XXXVII

a². Tarsus with its hinder edge compressed.

c¹. Primaries apparently only nine; bill not hooked at tip.

d¹. Bill very short, flat, broad at base, deeply cleft; wings very long.

HIRUNDINIDÆ.—SWALLOWS. XLII

d². Bill not very flat and deeply cleft; outer primary never twice as long as the innermost.

e¹. Bill more or less conical, broad at base.

f¹. Bill rather long, often longer than head, without notch at tip or bristles at base.

ICTERIDÆ.—ORIOLES, BLACKBIRDS, ETC. XXXIX

f². Bill shorter than head, often notched at tip, usually with bristles at base.

FRINGILLIDÆ.—FINCHES, SPARROWS, ETC. XL

f³. Bill stout, upper mandible curved with slight tooth near the middle of the cutting edge; color chiefly red and yellow.

TANAGRIDÆ.—TANAGERS. XLI

e². Bill not conoid.

g¹. Hind claw long and nearly straight, generally longer than its toe; tertials much elongated, reaching nearly to tips of primaries.

MOTACILLIDÆ.—WAGTAILS AND PIPITS. XLVII

g². Hind claw short and curved, generally shorter than its claw; tertials short, not nearly reaching to the tip of primaries.

MNIOTILTIDÆ.—WOOD WARBLERS. XLVI

c⁴. Primaries evidently ten, the first developed but short, rarely half the length of the next; or else bill hooked at tip.

h¹. Front of tarsus covered with transverse four-sided scales.

i¹. Bill strongly hooked and notched at tip.

LANIIDÆ.—SHRIKES. XLIV.

i². Bill not strongly hooked or not hooked at all.

j¹. Head with conspicuous crest; tail, in our species, tipped with yellow; bill slightly hooked and notched at tip.

AMPELIDÆ.—WAXWINGS. XLIII

j². Head usually not crested; tail not tipped with yellow.

k¹. Back generally olive green; bill slightly hooked and notched at tip; length five to seven inches.

VIREONIDÆ.—VIREOS. XLV

k². Back not generally olive green.

l¹. Tail feathers stiff, pointed; bill slender, curved downward.

CERTHIIDÆ.—CREEPERS. XLIX

l². Tail feathers more or less soft, not pointed.

m¹. Nasal feathers directed forward on bill, usually covering the nostrils.

n¹. Birds of large size, length over ten inches.

CORVIDÆ.—CROWS, JAYS, ETC. XXXVIII

n². Birds of small size; length under ten inches (except genus *Harporhynchus*).

o¹. Bill notched toward the tip, very slender.

SYLVIIDÆ.—KINGLETS AND GNATCATCHERS. LI

o². Bill not notched.

PARIDÆ.—NUTHATCHES AND TITMICE. L

*m*². Nasal feathers erect or directed backwards, not covering nostrils; bill more or less curved downwards.

TROGLODYTIDÆ.—WRENS, THRASHERS, ETC. XLVIII

*h*². Front of tarsus not divided into scales except at extreme lower portion.

*p*¹. Small birds; length under five inches; young, not spotted.

SYLVIIDÆ.—KINGLETS AND GNATCATCHERS. LI

p^a. Larger birds; length over five inches; young distinctly spotted.

TURDIDÆ.—THRUSHES, ETC. LII

A. ORDER PYGOPODES. DIVERS.

SUBORDER PODICIPEDES. GREBES.

I. FAMILY PODICIPIDÆ. GREBES.

*a*¹. Bill slender, straight, rather acute; its length rather more than twice its depth at base.

*b*¹. Neck much shorter than body.

COLYMBUS. 1

*a*². Bill stout, somewhat hooked; its length not quite twice its greatest depth.

PODILYMBUS. 2

1. GENUS COLYMBUS LINNÆUS.

*a*¹. Wing more than 6.00; bill about as long as head. Subgenus *Colymbus*.

*b*¹. Length 18.00, or over.

C. holboëllii (Reinh.) 1

*a*². Wing not over 6.00; bill much shorter than head. Subgenus *Dytex*.

*c*¹. Bill compressed; deeper than wide at base.

C. auritus Linn. 2

*c*². Bill depressed; wider than deep at base.

C. nigricollis californicus (Heerm.) 3

Subgenus COLYMBUS.

1. (2.) *Colymbus holboëllii* (REINH.).

Holboëll's Grebe.

Synonym, RED-NECKED GREBE.

Adult.—Front and sides of neck rich brownish-red; throat and sides of head ashy, whitening where it joins the dark color of the crown, the feathers slightly ruffled; top of head with slight occipital crest; upper parts, generally, and wings dark brown, the feathers of the back paler edged; primaries brown, part of inner quills white; lower parts pale silvery-ash, the sides watered or obscurely mottled, sometimes obviously speckled with dusky; bill black, more or less yellow at base; eye carmine. (Wheaton.) *Immature*.—Above, blackish; sides of head with white stripes; fore part and sides of neck light rusty; otherwise as in adult.

Length, 18.00-20.00; wing, 7.30-8.10; bill, 1.65-2.40.

RANGE.—North America, from South Carolina and Nebraska to Arctic coast and Greenland, also northeastern Asia south to Japan. Breeds from Minnesota northward.

Nest, a mass of floating material fastened to reeds. *Eggs*, 2-7, dull white, tinged with greenish; 2.30 by 1.35.

Rare migrant and possibly winter resident. It has only been reported from the northern part of the State, where it has been taken in spring. Dr. J. L. Hancock, of Chicago, Ill., reports it at Wolf Lake, Indiana, in the spring of 1883, also at Park Side, Ill., April 29, 1883. Mr. Robert Ridgway (*Birds of Illinois*, Vol. II, pp. 259-261) gives it as a winter visitant to Illinois. Its summer home is farther north, mainly much to the northward of the United States. Dr. T. S. Roberts (*The Auk*, April, 1890, p. 213) found it breeding in limited numbers in west-central Minnesota. It breeds abundantly along the Yukon River, where Mr. Robert Kennicott saw it and gave an account of its nest and habits. These are very similar to those of other grebes.

Subgenus *DYTES* KAUP.

*2. (3.) **Colymbus auritus** LINN.

Horned Grebe.

Adult in Summer.—Above, dark brown, the feathers paler edged; below, silvery-white, the sides mixed dusky and reddish; most of the secondaries white; foreneck and upper breast brownish-red; head, glossy black, including the ruff; a broad band over the eye to and including occipital crests, brownish-yellow; bill, black, yellow tipped (Wheaton); eye carmine. **Adult in Winter and Immature.**—Above, including top of head, dusky gray; sides of head and lower parts, white; the chest and sides more or less grayish.

Length, 12.50-15.25; wing, 5.75; bill, 1.00.

RANGE.—Northern hemisphere, in North America south to Gulf States. Breeds from northern Indiana and southern Michigan northward. Winters from Indiana and southern New York southward.

Nest, of water plants attached to reeds and floating on the surface of the water. *Eggs*, 2-7; whitish or greenish; 1.78 by 1.20.

Regular migrant in some numbers, but never abundant. Some are winter residents in suitable localities. In the northern part of the State among the lakes and marshes it breeds. Mr. Geo. L. Toppan has a young bird of this species, in downy plumage, taken at Sheffield, Ind., May 24, 1878. He considers it more common in winter. Dr.

Species marked with an asterisk () breed within the State.

F. W. Langdon, in "Summer Birds of a Northern Ohio Marsh," notes having taken two sets of eggs which he thinks were of this species July 2, 1880. They are known to breed in numbers at St. Clair Flats, Mich. Most often seen in March, April and May, October and November. In the spring of 1883 they were more numerous in the Whitewater Valley than I ever knew them. They were found from April 15 to May 19. Prof. B. W. Evermann reports it from Vigo County January 5, 1891. Mr. E. M. C. Hobbs, Salem, Ind., has an immature specimen taken alive in a barnyard near Harrisontown, Washington County, about Christmas, 1897. In habits there is much similarity among all the Grebes. To this one, in particular, attention has been called because of its habit of quietly sinking beneath the water, the bill being last to disappear, leaving no ripple to mark its place upon the surface.

3. (4.) *Colymbus nigricollis californicus* (HERM).

American Eared Grebe.

Adult Male.—Long ear-tufts of rich yellowish-brown; head and neck all round, black; upper parts, grayish-black; sides, chestnut; lower parts, silvery-gray; primaries, dark chestnut; secondaries white, dusky at the base. *Young*.—Similar, the ear-tufts wanting and the colors generally duller. (McIlwraith.)

Length, 12.00-14.00; wing, 5.20-5.50; bill, .95-1.10.

RANGE.—North America from Guatemala to Great Slave Lake; east to Indiana and Ontario. Breeds from Wyoming northward.

Nest and Eggs, similar to those of *C. auritus*.

This species is an accidental visitor or perhaps a rare migrant. The first record of its capture in Indiana was a specimen shot four miles north of Brookville by Mr. Edward Hughes, May 19, 1883. A second specimen was killed at Brookville, Nov. 5, 1886. These are the only specimens I have seen from the State, and I do not know that it has been taken farther eastward. Dr. Brayton says it is a winter visitor on Lake Michigan. Mr. Ridgway says it may possibly breed in Illinois. Mr. J. Grafton Parker has twice noted it in Cook County near the Indiana line, but he records it as extremely rare. One day during April, 1890, a flock of six flew over Mud Lake like a flock of ducks. He supposed he was shooting into a flock of ducks, and one fell, proving to be a grebe of this species. He also observed one on the Calumet River a half-mile from the Indiana line near Hammond. Mr. N. S. Goss, in "The Auk" for January, 1884, pp. 18-20, gives a very interesting description of the breeding of about one hundred pairs of these

birds found at Como Lake, Wyoming. He says: "The nests were in a narrow strip of rushes growing in water eighteen inches deep, and about one hundred and thirty feet from the shore. * * * * I collected the eggs from two nests, five in each; and counted from where I stood over twenty nests with from one to five eggs each. Quite a number of others were completed, but without eggs, and still others were building. The floating nests were made of old broken rushes, weeds and debris from the bottom, and were partially filled in and around the standing, growing rushes. There were no feathers or other kind of lining. They were from five to ten inches in diameter; the outer edge or rim was from two to three inches above the water. The eggs in several touched the water, and were more or less stained in their wet beds. The color of the eggs when fresh was white, with a slight bluish shade. The average measurements of the ten eggs was 1.81 by 1.20 inches." The same careful observer notes that in leaving their nests the birds would dive and come up quite a distance away out in the open lake and, when returning to their nests, would dive out in the lake and come up among the rushes. He says in no instance did he see them swim to or from their nests, but adds, they may do so when not disturbed.

2. GENUS *PODILYMBUS* LESSON.

♂¹. Wing 5.00 or less.

P. podiceps (Linn.) 4

*4. (6.) *Podilymbus podiceps* (LINN.)

Pied-billed Grebe.

Synonyms, WATER WITCH, DABCHICK, DIDAPPER, DIDIPPER, DIPPER, HELL-DIVER.

Adult in Summer.—Above, dusky grayish brown, top of the head darker; sides of head lighter; inner webs of the secondaries tipped with white; below, grayish white, everywhere spotted with dusky; chin, throat and a spot at the base of the mandible, black; bill, white, a black band around it at the middle. *Adult in Winter and Immature*.—Similar, but lacking the black throat patch, and the distinctive marks on the bill. *Downy Young*.—Head and neck with black and white stripes.

Length, 12.00-15.00; wing, 4.50-5.00.

RANGE.—America, from Argentine Republic and Chili to Hudson Bay and Great Slave Lake. Breeds from Florida northward. Winters from southern Missouri, southern Illinois and New Jersey southward.

Nest, a floating island of marsh vegetation and mud fastened to water plants. *Eggs*, 4-7, whitish with greenish shadings; 1.72 by 1.99.

Prof. Cooke notes (Bird Migration in the Mississippi Valley, p. 54) that it "winters wherever there is open water, from Illinois southward, and breeds from southern Indiana, Illinois, Missouri and eastern Kansas northward." It has also been found breeding in Florida. It has never been reported as wintering in Indiana, and is known as a migrant, or summer resident only in this State. Throughout the greater part of the State it is seen regularly, but not very commonly, during the migrations, and is, perhaps, more commonly observed in spring. The creeks, ponds, rivers and lakes are frequented by it. Where there is no water it is comparatively unknown. Owing to the screen of the season's vegetation it is not so often noted in fall. Throughout the lake region of northern Indiana it is a common summer resident. It arrives about April 1 and can be found in all lakes, rivers and muddy ponds until the early part of November. In Lake, Starke and Laporte counties it is reported as breeding abundantly, and sparingly in Steuben County. Mr. Robert Ridgway (Bull. Nuttall Orn. Club., Jan., 1882, p. 22) reports it breeding commonly in swamps in Knox County. Prof. B. W. Evermann found it breeding May 30, 1890, at Terre Haute.

The following account of the nesting of this species near Sandusky, O., by Dr. F. W. Langdon, in his "Summer Birds of a Northern Ohio Marsh," will give a good idea of the floating nest. He says: "I desire here to testify to the fact that the nest of the present species does float. * * * * The little floating island of decayed vegetation, held together by mud and moss, which constitutes the nest of this species, is a veritable ornithological curiosity. Imagine a 'pancake' of what appears to be mud, measuring twelve to fifteen inches in diameter, and rising two or three inches above the water, which may be from one to three feet in depth; anchor it to the bottom with a few concealed blades of 'sawgrass' in a little open bay, leaving its *circumference entirely free*; remove a mass of wet muck from its rounded top and you expose seven or eight soiled brownish-white eggs, resting in a depression, the bottom of which is less than an inch from the water; the whole mass is constantly damp. * * * * The anchoring blades of coarse sawgrass, or flags, being always longer than is necessary to reach the bottom, permit of considerable lateral and vertical movement of the nest, and so effectually provide against drowning of the eggs by any ordinary rise of water level, such as frequently occurs during the prevalence of strong easterly winds on the

lake. A small bunch of sawgrass already growing in a suitable situation is evidently selected as a nucleus for the nest, and the tops bent so as to form a part of it. During the day we invariably found the eggs concealed by a covering of muck, as above described; but as we ascertained by repeated visits at night and in the early morning they are uncovered at dusk by the bird, who incubates them until the morning sun relieves her of her task."

Mr. Ruthven Deane informs me that Mr. Hatfield found it breeding at English Lake, June 3, 1892. Mr. J. E. Gould, of Columbus, Ohio, took a nest at the same lake July 1, 1891, that contained nine eggs. The same gentleman, the latter part of the previous month, found several pairs of Terns despoiling the nest of a Grebe. The nest had two or more eggs in it, one was found in the nest and one outside.

This Grebe dives forward very suddenly. Its motions are so quick that it often escapes the shots fired at it. It is often noted to apparently disappear. After diving it arises to the surface of the water and projects only the bill, the rest of the bird remaining below the water. It thus remains invisible. It is said to be able to settle backwards and disappear from view beneath the water. This is done quietly so that the casual observer wonders what has become of it.

The earliest spring record from Brookville, and it is the earliest for the State, is March 17, 1884, and the latest first arrival from the same station is April 18, 1885. Mr. J. O. Dunn reports it from the vicinity of Chicago, near the Indiana line. March 23, 1894. Usually, however, they reach that latitude between April 1 and 15. In the late summer they begin to journey south in October, and a few remain into November (Hillsdale, Michigan, November 11, 1894), possibly until severe freezing weather.

SUBORDER CEPPHI. LOONS AND AUKS.

II. FAMILY URINATORIDÆ. LOONS.

Characters same as for family.

URINATOR. 3

3. GENUS URINATOR CUVIER.

α^1 . Tarsus shorter than middle toe without claw; wing 13. or more.

U. imber (Gunn.). 5

α^2 . Tarsus longer than middle toe with claw; wing under 12.

U. lumme (Gunn.). 6

5. (7.) **Urinator imber** (GUNN.).

Loon.

Synonym, GREAT NORTHERN DIVER.

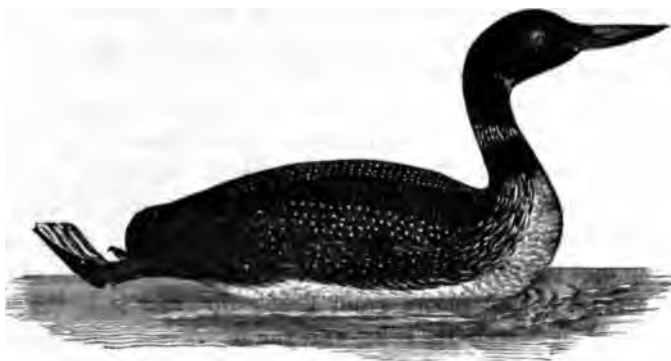
Adult.—Above, black; back, with square white spots; head and neck, glossy black, with violet and green reflections; a patch of white

streaks on each side of the neck, and one on the throat; below, white; bill, black. *Immature*.—Above, dark gray, feathers edged with paler; below, white, dusky on the sides; bill, yellowish green and dusky.

Length, 28.00-36.00; wing, 13.00-15.25; bill, 2.75-3.50.

RANGE.—Northern part Northern Hemisphere; in America, south to Gulf of Mexico. Breeds from Indiana, Minnesota and northern New England northward.

Nest, a depression in the ground near the water, sometimes lined with grass and weeds. **Eggs**, 2-3, brownish, spotted and blotched with darker brown.



Loon.

The Loon is a regular migrant throughout the State in some numbers. They sometimes remain through the winter, but most of them do not. Mr. J. W. Byrkit informs me that they are permanent residents in Laporte County. He says they are sometimes caught by fishermen on Lake Michigan, near Michigan City, Indiana, "in gill nets and on hooks in thirty fathoms of water." In the Whitewater Valley I have never found them except in April. That seems to be the month of their principal spring migration, though in the northern part of the State the advance guard makes itself noticeable in some numbers a month earlier. The movement southward begins in September, rarely August, and continues through November. Mr. J. E. Beasley reports two specimens from Boone County August 25. Hon. R. Wes. McBride says (Proc. Indiana Academy of Science, 1891, pp. 166-7): "It is a summer resident of Steuben County, and breeds in at least two of the many beautiful lakes in that county. Their eggs have been taken at Lake James and Crooked Lake. I have been familiar with those lakes for more than twenty years, and have never failed to find them there in summer. I have also seen them in the breeding season in Hamilton Lake and Golden Lake, also in Steuben County;

in Turkey Lake, on the line between Steuben and Lagrange counties, and in Bear Lake, Noble County." Mr. C. L. Cass notes it as breeding in Steuben County, and Mr. W. B. Van Gorder in Noble County. Mrs. Jane L. Hine is informed that they formerly nested in Steuben County, on the point of land extending between the Twin Lakes of the Wood, also at Big Turkey Lake.

In 1876 Nelson gave it as "very common winter resident upon Lake Michigan," * * * * "of uncommon occurrence during summer" in Cook County, Illinois. Mr. J. Grafton Parker says of the same county and Lake County, Indiana: "Although not common, it is the common Loon with us. It can be found at Wolf and Calumet lakes during April, October and November, and until late years bred about these lakes." In the State Museum in the State House there is a young Loon marked Zionsville, June, 1885. Mr. Stephen A. Warrnie informs me that some breed at St. Clair Flats, Michigan.

The Loon's nest is simply a depression in bare ground, or a collection of a few sticks, weeds and swamp vegetation on land, or sometimes a depression in the top of a muskrat house.

Its habits are very similar to those of the Grebes. It swims lower in the water, often with little more than neck and head exposed; is ever alert for danger; has come to regard every human being as its enemy; is rapid in movement, diving at the flash of a gun, and coming up out of range.

The cry of the Loon is one of the characteristic sounds of the more quiet lakes of northern North America. Its weird, melancholy notes convey to those who have heard them impressions of the most lasting character.

6. (11.) **Urinator lumme.** (GUNN.).

Red-throated Loon.

Adult.—Blackish; below, white; dark along the sides and on the vent and crissum; most of the head and fore neck, bluish-gray; the throat with a large *chestnut* patch; hind neck, sharply streaked with white on a blackish ground; bill, black. (Wheaton.) *Immature*.—Lacking the markings on the head and neck; the back marked with round or oval spots.

Length, 18.00-27.00; wings, 10.00-11.50; bill, 2.25.

RANGE.—Northern part of the Northern Hemisphere. South in winter to South Carolina and southern Indiana. Breeds from Manitoba and Labrador northward.

Nest, similar to that of *U. imber*. *Eggs*, 2, pale green, spotted with brown.

Rare winter resident and occasional migrant, breeding far to the northward of the United States. One shot from a flock of five near Brookville, February 23, 1885. That morning the thermometer registered 10 degrees below zero. For several mornings previous the weather had been equally severe. The canal, most of the smaller streams, ponds and the rivers, except where there were rapids, were frozen over. In one of these open places the Loons were found. I am informed by Mr. Charles Dury, of Cincinnati, of a specimen that was killed near Chalmers several years ago. Mr. C. A. Stockbridge reports it as a rare visitor at Ft. Wayne. Mr. Ruthven Deane found one at English Lake, May 4, and another May 11, 1890. Dr. Langdon noted two or three in the vicinity of Cincinnati, and Dr. Wheaton says it is not rare on Lake Erie. Mr. Nelson says it is a very common winter resident upon Lake Michigan. Prof. Cook reports it from Michigan. The Loons subsist chiefly upon fish, and their flesh has a fishy flavor, rendering them unfit for food, although it is said they are eaten by the Indians. They also, while engaged in fishing, are reported to become entangled in the fishermen's nets.

III. FAMILY ALCIDÆ. AUKS, MURRES AND PUFFINS.

SUBFAMILY ALCINÆ. AUKS AND MURRES.

*a*¹. Bill not very short; nostril concealed or enclosed in dense velvety feathering; secondaries tipped with white.

*b*¹. Bill narrow; culmen slightly curved, both mandibles destitute of grooves; tail rounded, its feathers not pointed. URIA. 4

. 4. GENUS URIA BRISSON.

*a*¹. Bill under 1.60.

U. lomvia (Linn.). 7

7. (31.) *Uria lomvia* (LINN.).

Brünnich's Murre.

Synonym, THICK-BILLED MURRE.

Adult.—Above and throat and neck, sooty black; secondaries, tipped with white; other lower parts, white; the cutting edge, towards the base of the upper mandible, thickened and extending outward beyond the edge of the lower mandible.

Length, 14.50-18.50; wing, 7.45-8.80; bill, 1.45-1.50; depth of bill at nostril, .47.

RANGE.—“Coasts and islands of the North Atlantic and Eastern Arctic oceans; south to the lakes of northern New York and the coast of New Jersey.” (A. O. U.) Accidental west to Michigan and Indiana and south to South Carolina. Breeds from the Gulf of St. Lawrence northward.

Nest, in communities on inaccessible cliffs. *Egg*, one, pear shaped white, greenish, brownish or yellowish, plain or marked with blotches, or zigzag markings of brown and black.

While at Indianapolis the last week in December, 1896, Prof. W. S. Blatchley, State Geologist of Indiana, told me of a strange bird that had been taken near there. His information was it was some sort of a Guillemot. I learned it had been sent for mounting to Mr. J. E. Beasley, at Lebanon, Indiana, and that the same taxidermist had received others. Upon my return home I found a letter from my friend, Mr. Ruthven Deane, informing me that Mr. F. M. Woodruff, of the Chicago Academy of Science, had received a Murre from Indiana. A few days later this information was supplemented by a letter from Mr. Woodruff informing me that the specimen was *Uria lomvia*.

In looking over my accumulated mail I found a report from Mr. A. W. Hamilton, Zanesville, Indiana, of the capture of a specimen near there. Prof. E. S. Moseley wrote me of the capture of four specimens near Sandusky, Ohio, and Mr. J. E. Beasley, in a note, said he had received four specimens. Thus the total number of records received in a few days was ten. I give herewith data concerning the specimens.

The first specimen mentioned above was brought to Mr. F. M. Noe, a dealer in natural history specimens, of Indianapolis, December 17, 1896, by a boy who told him that it had been taken alive the preceding Sunday, December 13, near Schofield's old mill, on Fall Creek, about seven miles north of that city. The specimen is now in the collection in the State Geologist's office at the capitol. The specimen reported by Mr. Hamilton was taken by Mr. J. W. Roe, of Zanesville, Indiana, in the northern part of Wells County, December 18, 1896. It was first observed slowly moving about in an open field and was shot at long range. This specimen is in my collection.

On December 28 Mr. J. E. Beasley wrote me that he had in his possession four of these birds from four different Indiana localities. One was the specimen sent by Mr. Noe. Another was brought to him alive by Mr. David Johnson, from Hazelrigg, Boone County, December 18. Mr. A. W. Beck, of Hazelrigg, informs me that it was captured alive about December 15. Mr. Johnson was driving along the road near that town and saw the bird in a field near by. He caught

it and kept it two or three days. It was a persistent diver when put into the water; would offer to fight when approached, and did not make much effort to get away. The third bird was sent to him by Mr. J. F. Warner, of Fowler, Benton County. Mr. Warner has written me the bird was captured on the road about three miles west of Fowler by a teamster, whose name is unknown to him, about December 20. He adds that he never saw but one other bird of this kind. It was caught near Reynolds, White County, Indiana, by Mr. Linck, a night watchman on the Panhandle R. R., in March, 1869. He adds, "it lived three or four days and died in my possession, but was not preserved." The fourth was received by the taxidermist, about December 20, from Mr. A. C. Littleton, Pickard, Indiana. It was caught alive by Mr. Abel Christy, about three-fourths of a mile north of that place, December 10, and was kept alive until it was sent to be mounted, but died on the road.

Prof. E. L. Moseley, Sandusky, Ohio, informs me that the four specimens he reported were taken within twenty miles of Sandusky, December 19, 1896.

Bulletin No. 13, of the Wilson Ornithological Chapter of the Agassiz Association, March 30, 1897, p. 16, records the identification of two specimens by Rev. J. M. Keck, Mentor, Ohio, December 19, 1896, as *Uria troile*. Mr. Lynds Jones made a careful examination of the one specimen taken and found it to be an immature Brünnich's Murre, *Uria lomvia*. It was captured near Painesville, Ohio, on Lake Erie.

A fine adult male was taken by a twelve-year-old boy on the Iroquois River, Iroquois Township, Newton County, Indiana, one and a half miles from Foresman, near what is known as the old Indian Ford, December 31, 1896. It was shipped to a firm on South Water street, Chicago, where Mr. F. M. Woodruff obtained it, and it is now in his collection. He obtained the information given above from the postmaster at Foresman, Indiana, and kindly sent it to me.

The Bulletin of the Michigan Ornithological Club, January, 1897, p. 10, refers to a Murre identified as *Uria troile*, which Mr. N. A. Wood informs me is shown by reëxamination to be *Uria lomvia*. The specimen is an adult male and was shot from a flock of several near Gibraltar, Michigan, December 26, 1896, by some duck hunters. The specimen is, I understand, in the museum of the University of Michigan at Ann Arbor. In the same publication, on page 8, is a reference to two Black Guillemots taken at the St. Clair Flats near Detroit, Michigan. From a letter received from Mr. W. A. Davidson, Detroit, Michigan, I gather that one of the two birds noted is in the possession of Mr. C. Havens of that city. The other belongs to a lighthouse-

keeper, whose name he does not know, at the St. Clair Flats. Evidently both specimens are *Uria lomvia*. It is possible a careful examination of the specimens will show that these also belong to this species.

Brünnich's Murre has, as I have been informed, been reported the present winter from other interior localities. It has, I believe, however, never before been authentically reported far from the ocean. Mr. Robert Ridgway informs me that they have this winter ranged down the Atlantic coast as far as South Carolina. It would seem probable that some storm had driven them far out of their usual range. Evidently those noted herein were carried inland and dispersed about the same time, perhaps by the same storm. They were all taken within a few days. Only twenty-one days elapsed from the date when the first was obtained until the last was in the hands of a naturalist. This is its first record from Indiana, except that reported by Mr. Warner which, unfortunately, is not verified by the specimen. It will be of interest to hear of other records of the occurrence of this species inland. It will be noted that there is a specimen preserved in a public museum in Indiana and in Michigan to verify the records from those States. It is to be hoped that one of the Ohio specimens may be secured for a like purpose.

B. ORDER LONGIPENNES. LONG-WINGED SWIMMERS.

IV. FAMILY STERCORARIIDÆ. SKUAS AND JAEGER.

*a*¹. No white at base of the primaries; tarsus longer than middle toe with claw; middle tail feathers, in adult, projecting much beyond the others.

STERCORARIUS. 5

5. GENUS STERCORARIUS BRISSON.

*a*¹. Bill 1.45 or more; tarsus 2.00 or more.

S. pomarinus (Temm.). 8

8. (36.) *Stercorarius pomarinus* (TEMME).

Pomarine Jaeger.

Adult, Light Phase.—Middle tail feathers projecting about four inches, *not pointed*; bill, 1.45 or more; tarsus, 2.00 or more. "Top and sides of head, with upper parts, sooty slate or dusky; rest of head and neck, including nape, together with lower parts, white, the ear-covert region tinged with straw-yellow, and the lower tail-coverts slaty. *Young*.—Head, neck and lower parts, dull buff, everywhere barred with dusky; upper parts, brownish dusky, the feathers of back,

etc., tipped with buff, the rump and upper tail-coverts spotted with same. *Adult, Dark Phase*.—Entirely dark, sooty slate, with a plumbeous cast in certain lights. *Young*.—Entirely sooty slate, the lower parts more or less barred with buff." (Ridgw.) The descriptions are of extreme examples of coloration. Specimens are found showing every possible intermediate condition of plumage.

Length, 20.00-23.00; wing, 13.50-14.00; tail, 8.00-9.00; bill, 1.45-1.75; tarsus, 2.00-2.10.

RANGE.—Northern portion of Northern Hemisphere, principally on the seas, but also visiting the larger inland waters. In America, south to Nebraska, Great Lakes and New Jersey. Breeds far northward.

Nest, of moss and grass on the ground. *Eggs*, 2 to 3, grayish-olive, spotted with brown.

The only record I know of its occurrence is that given by Dr. A. W. Brayton (Trans. Ind. Hort. Soc., 1879, p. 150): "A rare winter visitant to Lake Michigan. October 9, 1876, in company with my friend, Mr. E. W. Nelson, * * * we saw a fine specimen of this bird flying along the lake shore near the State line." Mr. E. W. Nelson notes a record under the same date which is possibly the same. Birds of Northeastern Illinois, p. 145.) Prof. E. L. Moseley reports a specimen shot at Sandusky, Ohio, October, 1889, and the late W. H. Collins reported one specimen taken on the Detroit River, and now in the collection of the Museum of Comparative Zoology, Cambridge, Massachusetts. (Cook. Birds of Michigan, p. 31.) From these notes it would appear that the bird is of occasional occurrence on the Great Lakes in fall, and doubtless in winter and spring. They spend the warmer parts of the year far to the northward, much of the time frequenting places where other water fowl, particularly Terns, congregate. They prey upon Gulls and Terns. By reason of their powerful wings they overtake their victim and compel it to drop or disgorge its food. They are called "Pirates," "Gullchasers," "Sea Hawks" and "Jaegers" (hunters), each of which terms represent some one's attempt to fit the birds with a name that will express their notable habits. Mr. Basil Hicks Dutcher has given a good account of the habits of birds of this genus on the Long Island coast in *The Auk*, April 1889, pp. 125-126.

V. FAMILY LARIDÆ. GULLS AND TERNS.

α^1 Bill more or less hooked; general color chiefly white with a darker bluish-gray or slaty mantle. Subfamily LARINÆ. GULLS.

b^1 . Hind toe rudimentary or wanting, with minute claw or none. *RISSA*.

b^2 . Hind toe small, but with perfect claw.

c^1 . Tail even.

LARUS. 6

c^2 . Tail forked.

XEMA.

α^2 . Bill not hooked, but narrow and pointed, the mandibles even; tail (in our species), deeply forked. Subfamily STERNINÆ. TERNS.

d^1 . Tail much more than one-third length of wing, its outer feathers narrow and pointed; toes well webbed.

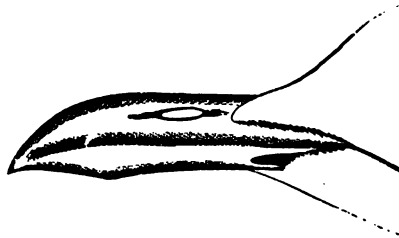
e^1 . Bill stout, its depth at base equal to one-third length of culmen.

GEOCHELIDON.

e^2 . Bill slender, its depth at base not one-third its length. *STERNA*. 7

d^2 . Tail little more than one-third wing; its outer feathers broad and rounded. *HYDROCHELIDON*. 8

SUBFAMILY LARINÆ. GULLS.

6. GENUS *LARUS* LINNÆUS.

Bill of a Gull much reduced.

α^1 . Length over 18.

b^1 . Primaries without black; pearl-gray, fading gradually into white at tips.

c^1 . Wing over 16.50.

L. glaucus Brünn. 9

c^2 . Wing 16.50 or less.

L. leucopterus Faber. 10

b^2 . Primaries crossed with black; shafts of primaries black in the black markings.

d^1 . Length over 22.; white tips of outer primary separated from the other white by band of black. *L. argentatus smithsonianus* Coues. 11

d^2 . Length 20. or less.

L. delawarensis Ord. 12

α^2 . Length under 16.

e^1 . Bill and feet reddish; wing over 11. *L. franklinii* Sw. & Rich. 13

e^2 . Bill black; feet red or yellow; wing under 11.

L. philadelphia (Ord). 14

9. (42.) *Larus glaucus* BRÜNN.

Glaucous Gull.

Synonym, *BURGOMASTER*.

Adult.—"Plumage, pure white, except the mantle, which is grayish-blue; bill, gamboge yellow, with a carmine patch toward the end of

the lower mandible; feet, flesh color." *Young*.—Above, yellowish-white, mottled with pale brown; breast and lower parts, gray; tail, white, mottled with brown.

Length, 26.00-32.00; wing, 16.75-18.75; tail, 7.40-8.50; bill, 2.30-2.70.

RANGE.—Northern part of Northern Hemisphere. In America, south to the Great Lakes and Long Island. Breeds from Greenland and Hudson Bay north.

Nest, of seaweed, grass and moss on ground. *Eggs*, 2-3, white, ashy or grayish-brown; 3.05 by 2.21.

Occasional visitor along Lake Michigan. Mr. J. W. Byrkit informs me of its occurrence near Michigan City. Mr. F. M. Woodruff has a beautiful specimen in white plumage that he killed at Millers, Ind., August 8, 1897. Prof. A. J. Cook reports it from Michigan localities, notably St. Joseph County, 1892. He also refers to the fact that Prof. Ludwig Kumlein has taken several specimens at Milwaukee, Wis. (Birds of Michigan, p. 31). Mr. E. W. Nelson (Birds of Northeastern Illinois, p. 145) notes that Dr. Hoy had taken three of these gulls near Racine, Wis. Careful attention needs to be paid to the larger gulls upon the lakes and larger streams during the colder portions of the year, in order that more accurate information may be had concerning them. Mr. L. M. Turner (Contr. to N. H. of Alaska, 1887, p. 125) says this gull is the earliest bird to arrive at St. Michaels, a few reaching there by the middle of April. Mr. Nelson (Cruise of the Steamer Corwin in the Arctic Ocean, p. 106) notes the different surroundings of this gull in Behring Sea, where it breeds on all the islands and shores, from those peculiar to it on the North Atlantic coast, where it is known as Ice Gull, and is so well known as the accompaniment of the ice pack of that region.

10. (43) *Larus leucopterus* FABER.

Iceland Gull.

Synonym, WHITE-WINGED GULL.

Adult.—"Primaries entirely white, or palest possible pearly-blue, fading insensibly into white at some distance from the end; their shafts straw-color; mantle, palest pearly blue; bill, yellow, with vermillion spot on lower mandible; feet, flesh colored or pale yellowish. *In Winter*.—Head and neck slightly touched with dusky. *Young*.—Impure white, with or without trace of pearly on the mantle; head, neck and upper parts mottled with pale brownish, sometimes quite dusky

on the back, the under parts a nearly uniform but very faint shade of the same, the quills and tail often imperfectly barred with the same." (Wheaton).

Length, 24.00-26.00; wing, 14.75-16.50; tail, 6.00-6.70; bill, 1.60-1.70.

RANGE.—Circumpolar regions. In America, south in winter to Massachusetts and the Great Lakes.

Nest, similar to that of *L. glaucus*. *Eggs*, similar, but smaller, 2.79 by 1.85.

Like the last mentioned species this is but an occasional winter visitor to the northern part of the State. Hon. R. Wes. McBride reports it from Dekalb County. It is noted by Nelson (Birds of Northeastern Illinois, p. 145) as: "A regular and not uncommon winter resident on Lake Michigan." Dr. A. W. Brayton (Trans. Indiana Hort. Soc., 1879, p. 150) also notes it as: "Not uncommon winter resident on Lake Michigan." This gull and the last species leave early and pass northward as rapidly as the waters open. According to Mr. E. W. Nelson (N. H. Coll. in Alaska, 1887, pp. 52 and 54) this is perhaps the most abundant gull along the coasts of Alaska, about the islands of Behring Sea, and along the lower Yukon River. Along the upper Yukon it is replaced by the American Herring Gull.

11. (51a.) *Larus argentatus smithsonianus* COUES.

American Herring Gull.

Synonym, SEA GULL.

Adult in Summer.—Feet, flesh color; bill, yellow, with a red spot; first primary tipped with white and separated from the larger white spot by a black bar; most of remainder of outer web black, and of inner web white; the second primary tipped similarly, and other primaries to and including the sixth, tipped with white; mantle, pale dull blue; the remainder of the plumage white. *Adult in Winter.*—Similar, but head and neck streaked with dusky. *Immature.*—"At first almost entire fuscous or sooty-brown, the feathers of the back, white-tipped or not; size, at the minimum given. As it grows old, it gradually lightens; the head, neck and under parts are usually quite whitish before the markings of the quills are apparent, and before the blue begins to show, as it does, in patches mixed with brown; the black on the tail narrows to a bar, which disappears before the primaries gain their perfect pattern.

Length, 22.50-26.00; wing, 16.25-17.50; bill, 1.95-2.50.

RANGE.—North America, from Cuba and Lower California to Labrador and Alaska. Breeds from Maine and Michigan northward.

Nest, on ground or in trees; of grass. *Eggs*, 3, bluish white spotted and marked with different shades of brown, 2.85 by 2.01.

Common migrant throughout the State; locally, a winter visitor or winter resident. They occasionally remain throughout the winter in great numbers, especially on Lake Michigan, and in less numbers along the Ohio River. During winter floods they may be seen about any of the streams of the State. This is the most common gull found in the State, and is known popularly as "Sea Gull." In the Whitewater Valley it is most abundant in February and March, though it is sometimes seen in January, and in October. Mr. J. W. Byrkit notes that its occurrence about Michigan City is irregular. At times they will be very abundant, and then all will disappear for some time. Mr. J. Grafton Parker says in the vicinity of Chicago and at Millers, Ind., they are very common on Lake Michigan in winter. Hundreds of these birds congregate at the outlets of the sewers of Chicago, in the lake. They leave for the north in April, and are found breeding on Isle Royale, Gull Island, Thunder Bay Island, Mich., and other islands in the great lakes, and thence northward and along the Atlantic coast. As has been noted, these gulls frequent the upper Yukon Valley, and are replaced in the lower valley by *L. leucopterus*. Isle Royale is a well-known breeding ground for these birds. There they gather in great numbers before the ice has gone, and proceed to build nests, which vary from a hollow in the accumulations on the rocks to a mass of peat-like material, rootlets, moss and grass matted together placed upon the rocks, the gravelly beach, masses of driftwood on the shore, and even upon the rapidly melting icebergs themselves. In these nests the set of eggs, generally three, is laid some time after the first of May. (Daggett in O. & O., July, 1890, pp. 99, 100.) These birds suffer much from the plundering of fishermen and eggers. Finally, however, their work is done. What eggs have been left them are hatched, the young reared, and they turn their flight southward. They reach the lower end of Lake Michigan late in September, and occasionally the Ohio Valley early in October.

12. (54.) *Larus delawarensis* (ORD).

Ring-billed Gull.

Adult in Summer.—Similar to the last, but smaller; first primary black, but with a white spot on each web near the end; the second and succeeding primaries tipped with white, and the feathers one after

the other becoming lighter; "bill, *greenish-yellow*, encircled with a black band near the end, usually complete, sometimes defective; the tip and most of the cutting edges of the bill yellow; in high condition the angle of the mouth, and a small spot beside the black, red; *feet olivaceous*, obscured with dusky or bluish, and partly yellow; the web, bright chrome." *Immature*.—Similar to the same stage of the last species. All the changes are substantially the same as those of the species just described.

Length, 18.00-20.00; wing, 13.60-15.75; bill, 1.55-1.75.

RANGE.—North America, from Cuba and Mexico to Labrador and Manitoba. Breeds from North Dakota and Michigan northward.

Nest, on ground, in a depression; of grass. *Eggs*, 3 to 4, dark cream or buffy, blotched with brown and lavender gray, 2.39 by 1.71.

Regular migrant and local winter resident in the same localities as the last mentioned species. Mr. J. Grafton Parker says of it in the vicinity of Chicago, on Lake Michigan: "Quite common winter resident. Not so abundant as the Herring Gull. I have often found large numbers of these gulls collected at the sewer outlets into Lake Michigan. They stay here during the winter, except when we have our severe cold snaps. Then they go south." He also reports a large flock of old and young at Miller's, Ind., October 26, 1893. Over the State generally they are seen most numerous as migrants in March, April and May. They resemble the Herring Gull, except they are smaller and have the ring around the bill. Like the Herring Gull, they go north among the islands of the Great Lakes, and among the interior lakes of the northern United States and of the British possessions to breed. Mr. Charles L. Cass informs me of their breeding on the Beaver Islands, near Petoskey, Mich. It breeds abundantly on Gull Island, near Escanaba. Mr. Stebbins found this species and the Common Tern occupying an island about an acre in extent in Devil's Lake, Dakota, the first week of June. Mr. Stebbins says: "I don't suppose you could lay down a two-foot rule anywhere without each end of it striking a nest. It was common to find the terns and gulls breeding side by side. Most of the gulls' nests were in the grass, while those of the terns were in the sand. I did not find a gull's nest with more than three eggs, and a very few with two; whereas, several hollows were found with as many as eighteen terns' eggs in them, which had rolled together. Mr. Frazer noted them nesting in Labrador. Mr. E. E. Thompson notes them as breeding at Lake Winnepeg. Neither they, nor the Herring Gull, ordinarily reach the Arctic coast, but the northern limit of their breeding range seems to be unknown.

13. (59.) *Larus franklinii* SW. AND RICH.**Franklin's Gull.**

Adult Male.—"Eyelids, neck, rump, tail, and lower parts white, the latter, with the under part of the wings, deeply tinged with rich, rosy red; hood, black, descending downwards on the nape and throat; mantle and wings, bluish-gray; a band of black crosses the five outer primaries near the end; all the quill feathers are tipped with white. *Young*.—Changing with age as with other birds of this class." (McIlwraith.)

Length, 13.50-15.00; wing, 11.25; bill, 1.30.

RANGE.—Western South America, from Chili north through the interior of North America to the Arctic regions. Breeds from Iowa northward.

Nest, old water-soaked marsh vegetation about open water in marshy lakes. *Eggs*, 1-3; ground color from dark chocolate, sooty, creamy-brown and dirty-white, through all the shades of light green and light drab; variously marked with blotches or spots of umber, wreathed at larger end, and with lilac shell markings, 2.04 by 1.38.

Occasional migrant. It has been occasionally seen by Mr. J. W. Byrkit at Michigan City. Mr. Robert Ridgway has frequently seen gulls on the Wabash River, which he was disposed to regard as specimens of *Larus atricilla*, but which, after an acquaintance with that species, he considers as being more probably *L. franklinii*. (Dr. Wheaton, Birds of Ohio, p. 551.)

This gull is a bird of the interior, and not of the sea. Its migrations are through the interior of North America, and it breeds in the interior from southwestern Minnesota and Dakota northward through Manitoba. The northern limit of its breeding range has not been noted, and it is not given by the reports on Alaskan ornithology as having been taken in that region. Occasionally specimens are taken east of the Mississippi River, though the bulk of the species migrates to the westward of that stream. It has been reported from Illinois, near Warsaw (Bull. Nuttall. Orn. Club, Vol. V, p. 32); from Milwaukee, Wis. (Nelson, Birds of Northeastern Illinois, p. 146); mouth of Fox River, Wis. (Cooke, Bird Migration in Mississippi Valley, 1888, pp. 56-7); and near Hamilton Ontario (McIlwraith, Birds of Ontario, p. 49). An interesting account of their habits and nesting in Western Minnesota is given in the Ornithologist and Oologist, Vol. XI, 1886, pp. 54 and 55, from which I have gathered the description of the nest and eggs.

14. (60.) *Larus philadelphia* (ORD).**Bonaparte's Gull.**

Adult in Summer.—Size small; bill, black; mantle, pearly-blue; hood, slaty plumbeous, with white touches on the eyelids; many wing coverts white; feet chrome yellow, tinged with coral red, webs, vermillion; primaries, first five or six with the shafts white, except at tip; first white, with outer web and extreme tip black; second white, more broadly crossed with black; third to sixth or eighth, with the black successively lessening. *Adult in Winter.*—With no hood but a black auricular spot. *Immature.*—"Mottled and patched above with brown or gray, and usually a dusky bar on the wing; the tail, with a black bar; the primaries, with more black; the bill, dusky; much of the lower mandible, flesh-colored or yellowish, as are the feet."

Length, 12.00-14.00; wing, 9:50-10:50; bill, 1.12-1.25, very slender.

RANGE.—North America, from Bermudas to Hudson Bay, Labrador, and Alaska. Breeds from northern United States northward. Winters from Indiana and Illinois southward.

Nest, in tree or bush, or on stump; of sticks and grass, lined with soft material. *Eggs*, 3-4, grayish olive, tinged with greenish, and spotted with brown, 1.97 by 1.40.

Common migrant and rare winter visitor. Dr. J. L. Hancock informs me that while visiting Wolf Lake, in May, 1882, he was given a fresh specimen of a female of Bonaparte's Gull by a duck hunter, who had shot it near by. At the same time he was handed two quite fresh eggs, which were said to be those of the gull. The same day he saw another specimen flying over the same site, which was presumed to be the male. May 20, 1882, he saw three of these Gulls at different times during the day, one of which was shot for identification. The bulk of the species had gone further north to nest. It is best known as a migrant. In the Whitewater Valley I have never found it earlier than March 12. From that date until April 21 it may be looked for. It is not so common in fall on its way southward. In the northern part of the State, particularly in the vicinity of Lake Michigan, it is more numerous. There they remain until May, then depart to return again in October. They are reported to breed in the St. Clair Flats (Collins' Bull. Nuttall Orn. Club, Vol. V, 1880, p. 62), and on some of the islands of Saginaw Bay (Cook, Birds of Mich., p. 33), but I am not aware that this has been verified. It breeds generally on all the lakes of any size from the northern border of the United States, from the Atlantic to the Pacific coasts, toward the Arctic Ocean. On the

Alaskan coast of Bering Sea it is rare, and there is no record of its presence along the shore of the Arctic Ocean (Nelson, Cruise of the Corwin, p. 108). It has been noted as breeding at Ft. Yukon, along the Nelson River, and at York Factory on Hudson's Bay (McIlwraith, Birds of Ontario, p. 50).

SUBFAMILY STERNINÆ. TERNS.

7. GENUS STERNA LINNÆUS.

- a*¹. Wing more than 9.00.
 *b*¹. Both webs of outer tail feathers white. *S. dougalli* Montag. 17
 *b*². Both webs of outer tail feathers not white.
 *c*¹. Outer tail feathers with inner web dusky; outer web white. *S. forsteri* Nutt. 15
 *c*². Outer tail feathers with inner web white; outer web dusky. *S. hirundo* Linn. 16
*a*². Wing under 7. *S. antillarum* Less. 18

Subgenus STERNA.

15. (69.) *Sterna forsteri* NUTT.

Forster's Tern.

Adult in Summer.—Tail deeply forked; whole top of head black; other upper parts pearl gray; outer web of the outside pair of tail feathers white; inner web grayish or dusky toward the end; tips of secondaries, rump, sides of head, and lower parts white; bill dull orange, the tip blackish; edges of eyelids, black; legs and feet, orange red. *Adult in Winter*.—Similar, but top of head grayish; patch around eye, and over ear coverts black; tail not so deeply forked. *Immature*.—Above, including head, brownish, back and crown nearly uniform; tail feathers (except the outer web of the outer pair) tipped with dusky; bill dusky.

Length, 12.00-15.00; wing, 9.50-10.30; tail, 5.00-7.70; depth of fork, 2.30-5.00; bill, 1.50-1.65.

RANGE.—America, from Brazil to Virginia on Atlantic coast, to Manitoba in the interior. Breeds locally from Gulf of Mexico northward. Winters from Gulf coast southward.

Nest, a collection of marsh vegetation, placed upon drift or on the ground. *Eggs*, 3, varying from pale greenish to warm brownish drab, spotted with different shades of brown, 1.78 by 1.23.

Most places this tern is a rare migrant, but during the fall it is exceedingly abundant on Lake Michigan. Mr. B. W. Evermann noted it in Vigo County April 28 and May 19, 1888. Several specimens have been taken on Lake Maxinkuckee (Ulrey and Wallace, Proc. I. A. S., 1895, p. 149). Mr. Charles L. Cass noted one in Steuben

County, August 26, 1894. He also reports it as breeding at the St. Clair Flats, Mich. Mr. J. Grafton Parker notes it on Lake Michigan in April, August, September, and the early part of October. He reports one specimen taken at Miller's, Ind., August 13, 1896. He says that while a few Forster's Terns can be found during August at Miller's, in company with Wilson's, the bulk does not arrive until in September, after the Common Terns have gone south. Then enormous flocks can be seen flying south at Colehour, Ill., and Millers, Ind. It goes north to breed, but is the most common tern on Lake Michigan during the fall. Mr. E. W. Nelson, in *Birds of Northeastern Illinois*, notes its breeding there in small, reedy lakes. The young were able to fly about the middle of July. He gives the following account of its breeding: "Although I have been aware that *S. forsteri* nested in this vicinity for several years, it was not until the middle of June, 1876, that I had the pleasure of examining one of their nests. While we were collecting eggs among one of the wild rice patches, on Grass Lake, June 14, Mr. Douglass observed a pair of these terns hovering near a small patch of *Saggitaria* leaves growing in several feet of water, and rowing to the spot found the nest, which was a loosely built structure of coarse pieces of reeds resting upon a mass of floating plants, and concealed from view by the surrounding leaves. Upon the side of the nest was a single young bird, about to scramble into the water, but upon seeing Mr. Douglass, it crouched to avoid being observed, and was captured. A thorough search at the time failed to reveal any other young ones, so the adults, which had been darting and screaming about his head, were secured, with a second pair, which had espoused the cause of their companions. Their anxiety we afterwards found to be the proximity of an unfinished nest, similarly situated. That evening we found and secured two more young upon the nest found in the morning. The next morning fortune favored me, and, while passing between several floating masses of decaying vegetable matter, I observed four small heaps of wild rice stalks resting upon one of these masses, and, on a nearer view, to my delight, they proved to be the desired nests, containing eggs. The nests were situated in a line, and the two outer ones were not over twenty-five feet apart. The only materials used were pieces of wild rice stems, which were obviously brought from some distance, as the nearest patch of rice was several rods distant. The nests were quite bulky, the bases being two feet or more in diameter. The greatest depth was about eight inches, and the depression in the center so deep that, while sitting in the boat a rod away, the eggs were not visible. Two of the nests contained three eggs, and two contained two eggs, each. The

following are the measurements of three of the eggs, representing the amount of variation: 1.70 by 1.25, 1.75 by 1.20, 1.68 by 1.25. The ground color varies from pale greenish to warm, brownish-drab. The spots and shell markings are of a varying shade of brown, distributed much as in the other terns' eggs."

16. (70.) *Sterna hirundo* LINN.

Common Tern.

SYNONYMS, SEA SWALLOW, WILSON'S TERN.

Adult in Summer.—Similar to *S. forsteri*, but with the outer web of outside pair of tail feathers grayish or dusky, the inner web white; below, pale gray or grayish-white, whitening on the throat, and white on crissum; bill, red, blackish toward the tip; feet, red, lighter than bill. *Adult in Winter*.—Similar, but with forehead and crown white. *Immature*.—Similar, but the crown with more or less grayish; the upper parts with more or less buffy or brownish; tail, shorter; bill, brownish.

Length, 13.00-16.00; wing, 9.75-11.75; tail, 5.00-7.00; depth of fork, 3.50; bill, 1.25-1.50.

RANGE.—Northern part of Northern Hemisphere. In America, breeding locally from Florida and Arizona to Arctic coast. Winters from Virginia to Bermudas and Lower California.

Eggs, 2-3, generally deposited in a depression in the sand, varying from greenish to deep brown, spotted and blotched with brown, blackish, and lilac, 1.62 by 1.24.

Migrant; in some localities abundant. Some remain throughout the summer in the northern part of the State, where it may breed. These birds are later arriving in the spring and earlier returning in the fall than the last mentioned species. I have no record earlier than May 2, and generally it is the latter part of the month when they are chiefly noted. They seem to mark the end of the spring migrations. I noted one on the Whitewater River, June 3, 1884, which is the latest spring record for the southern part of the State. They leave for the south in August. It has been reported from Franklin County, Carroll and Marshall (Evermann), Monroe (Bollman), Allen (Stockbridge), Putnam (Earlle), Steuben (Cass), Laporte (Barber), Lake (Parker, Meyer and Tallman). This species is the common tern of the Atlantic coast, but Forster's is more common in the interior. They are said to breed at St. Clair Flats, on Heisterman's Island, in Saginaw Bay, "on muskrat houses in marshes," and in the Upper

Peninsula of Michigan (Cook, *Birds of Michigan*, p. 34). Mr. Ridgway notes that it breeds at Lake Koshkonong, Wis. (*Birds of Ill.*, Vol. II, p. 247). From there they breed in suitable localities northward to the Arctic coast. They have not been reported from Alaska (See article by William Brewster, *Bull. Nutt. Orn. Club*, 1879, p. 13).

17. (72) *Sterna dougalli* MONTAG.

Roseate Tern.

Adult in Summer.—Top of head and nape uniform black; mantle pale pearly-blue; upper tail coverts and tail silvery white; below pure white, tinged with pink; bill black, reddish at base; feet, coral-red. *Winter and Immature*.—Plumages change as in other species.

Length, 14.00-17.00; wing, 9.25-9.75; tail, 7.25-7.75; depth of fork, 3.50-4.50; B., 1.50.

RANGE.—North America, from West Indies and Central America on the Atlantic coast to Massachusetts; casually to Nova Scotia; accidental in the interior. Breeds throughout its United States range. Winters south of the United States.

Eggs, 3, deposited on ground, similar to those of the last species, 1.65 by 1.12.

Accidental visitor. Rare. Nothing has been added to the history of this bird in Indiana. I know of no other record of its occurrence in the State than that given by Dr. Haymond, in *Proceedings Philadelphia Academy of Science*, 1859, and later in the *Indiana Geological Survey*, 1869. Dr. Wheaton gave it upon the authority of Mr. Winslow as occurring on Lake Erie (*Birds of Ohio*, p. 562); Dr. Langdon notes its occurrence near Cincinnati (*Revised List of Cincinnati Birds*, p. 21); Prof. Cook and Dr. Gibbs both give it as a bird of Michigan. The former refers to a specimen recorded in the list of the collection of the Kent Scientific Institute. Of course, its occurrence in the interior can only be considered accidental.

SURGENT'S STERNULA BOIE.

*18. (74.) *Sterna antillarum* (LESS.).

Least Tern.

Adult in Summer.—Very small; "bill yellow, usually tipped with black; mantle, pale pearly grayish blue, unchanged on the rump and tail; a white frontal crescent, separating the black from the bill, bounded below by a black loreal stripe reaching the bill; shafts of two or more of the outer primaries, black on the upper surface, white underneath; feet, orange." (Wheaton). *Adult in Winter*.—Similar;

the lores, forehead and crown, grayish-white, pure white in front; bill, dull yellow or dusky; feet, pale yellow. *Immature*.—Similar to last, but lesser wing coverts dusky; scapulars with V-shaped dusky marks.

Length, 8.50-9.75; wing, 6.60; tail, 3.50; depth of fork, 1.75; bill, 1.20.

RANGE.—America, from Trinidad and Central America to Massachusetts and Minnesota, and California casually to Labrador. Breeds throughout most of its range. Winters south of the United States.

Nest, a hollow in the ground. *Eggs*, 2-4; drab or buff, spotted with brown and lilac.

Rare migrant over most of the State. A few are summer residents in the northern part. The only record from the southern part of the State is a specimen taken near Brookville, August 22, 1887, which is now in my collection. Mr. L. T. Meyer notes having seen it through the summer months in Lake County, and Dr. J. L. Hancock found a nest containing three eggs at Wolf Lake, Ind., June 5, 1882. Four birds were seen at the time. The nest was simply a depression on a pile of reeds in an almost inaccessible portion of a small inlet of water. The same gentleman informs me that Mr. George Clingman found it nesting at Hyde Park, Ill., May 27, 1875. He notes it was common some years ago, but is now rather rare. Prof. Cook notes it as a breeder at St. Clair Flats. Mr. Ridgway says it doubtless breeds in Illinois, although to his knowledge there is no record of its doing so. (Birds of Illinois, Vol. II, p. 248.)

GENUS HYDROCHELIDON Boie.

*a*¹. Tail not deeply forked; toes slightly webbed; black below in summer.

H. nigra surinamensis Gmel. 19

*19. (77.) **Hydrochelidon nigra surinamensis** (Gmel.).

Black Tern.

Synonym, SHORT-TAILED TERN.

Adult in Summer.—"Head, neck and under parts uniform jet black; back, wings and tail plumbeous; primaries unstriped; crissum pure white; bill black. *Adult in Winter and Immature*.—The black almost replaced by white on the forehead, sides of head and under parts; the crown, occiput, and neck behind, with the sides under the wings, being dusky gray; a dark auricular patch and another before the eye." *Young*.—The upper parts marked with dull brown.

Length, 9.25-9.75; wing, 8.25; tail, 3.75; depth of fork, .90; bill, 1.10.

RANGE.—America, from Chili to Alaska. Breeds in the interior from Indiana and Kansas northward. Winters south of the United States.

Nest, of grass, sedges, etc., on an elevation in a marsh or a depression in floating drift. *Eggs*, 3; brown or greenish, spotted and blotched with different shades of brown and lilac; 1.35 by .98.

Regular migrant in the southern part of the State and a summer resident about marshy lakes, at least from the Kankakee River northward. In some localities it breeds commonly. In the Whitewater Valley I have never found it common, but occasionally in May it may be seen moving northward. In this vicinity I have never found it in the fall. Mr. R. R. Moffitt reports it from White County as early as April, where he says it is to be found from April to August. Knox County, April 18, 1888. (Balmer.) They usually are noted in spring in May, and pass directly northward to their summer homes. The dates reported from the lakes of northwest Indiana are as early as are those of the most southerly stations. From May 6 to 15 they are first seen. About the marshes they are usually noted in flocks of ten to forty, and it is not unusual that a number of these birds are in immature plumage. They may be seen flying over the waters of the lake, skimming the surface of the marsh, and sometimes, swallow-like, insect catching over the wet meadows or even the dryer pasture land. While flying they utter a peculiar cry, sounding something like krik! krik! krik! Their principal food is insects. Often one may approach their homes and find none flying, but a canoe voyage through the marsh will show them sitting upon masses of roots of upturned pond lilies or other floating material. They nest upon floating half-decayed vegetation or other debris often where the water is not over two feet deep. Two broods appear to be reared in a season, as eggs are taken in May and July. I am indebted to Mr. Ruthven Deane, of Chicago, Ill., for the following notes furnished him by Mr. Joseph E. Gould, of Columbus, O. He visited English Lake twice, once each in June and July, 1891, and gives the following results of his observations upon the breeding habits of these Terns. He says: "I found the Black Terns nesting in what I suppose you call the 'South Marsh.' My first trip to the lake was made on June 17. The water was very high, and we were able to push our boat through the marsh at will. The nests were mere depressions made in the mass of floating drift. This drift was frequently very compact and dotted with growing vegetation. Sometimes a nest was found on a bunch of drift no larger than my hat. In no instance was more than one nest found on a drift, but in favorable localities two or three nests would be found within a small space. We were too

early to find full sets of eggs, but on July 1, when at the lake for one day, I secured several sets of three. Owing to the color of the eggs, the nests are sometimes hard to find, but if one remains quiet he will soon see the birds, which have gathered over his head on his first approach, silently returning to their nests, which can then be readily located. I caught several pair despoiling a nest of the Grebe (*Podilymbus podiceps*). I was attracted to the spot by the cries of the Terns, and found them hovering over the nest, which was a new one, containing two or more eggs, as I found one in the nest and one in the water lodged among the grass." Mr. J. Grafton Parker, Jr., says they breed abundantly about Hyde and Calumet lakes, Ill., and Wolf Lake, Ind. Mr. C. E. Aiken notes them as breeding abundantly in the marshes of the Calumet and Kankakee rivers. Mr. Charles Barber says they breed in Laporte County. Mr. R. R. Moffitt took two young in White County, May 17, 1886. I know of no record of their breeding in the north-central or northeastern part of the State. After the young are grown they collect with the adults in flocks about the lakes and along the sluggish rivers of the breeding region and remain until August or early September, at which time they pass to the southward. It is possible that some remain into October or even early November.

C. ORDER STEGANOPODES. TOTIPALMATE SWIMMERS.

VI. FAMILY ANHINGIDÆ. DARTERS.

Character same as family.

ANHINGA. 9

9. GENUS ANHINGA BRISSON.

VI. FAMILY ANHINGIDÆ. DARTERS.

a¹. Chiefly black; greenish luster above; neck with hair-like plumes.

A. anHINGA Linn 20

20. (118.) **AnHINGa anHINGa** (LINN.).

AnHINGa.

Synonym, SNAKE BIRD.

Adult in Summer.—Head, neck and body glossy greenish-black; other parts deep black; wing coverts streaked with gray; tail tipped with whitish; head and neck with hair-like feathers, the forward ones dirty white, the others black. *Adult Male in Winter*.—Similar, but lacking hair-like feathers. *Adult Female in Summer*.—Head, neck and breast grayish buff, a band of chestnut separating it from the

belly; neck with a few whitish feathers; rest of plumage black. *Adult Female in Winter*.—Similar, but lacking the whitish feathers on the neck. *Immature*.—Similar to the last, but lighter.

Length, 32.25-36.00; wing, 14.00; tail, 11.00; bill, 3.25.

RANGE.—Tropical and subtropical America, north to North Carolina and southern Illinois; casually to Indiana and northern Michigan. Breeds in the southern part of its United States range.

Nest, in bushes or trees, over water. *Eggs*, 3-5; bluish- or greenish-white; 2.15 by 1.35.

The Anhinga can only be counted as an accidental visitor in Indiana. Mr. Robert Ridgway says: "It appears to be a regular summer resident in the extreme southern portion of Illinois," referring particularly to the vicinity of Cairo. (Birds of Illinois, Vol. II, 209.) There are but two records for this State. Mr. J. E. Beasley, of Lebanon, Ind., for many years a resident of Indianapolis, informs me that he killed a pair of Anhingas on the "Broad Cut" of the canal, just north of the latter city, in 1858. Mr. Fletcher M. Noe, of Indianapolis, says he received a male which was killed some two miles south of that city, on White River. Prof. B. W. Evermann noted Mr. Noe's report of this in the "American Naturalist," March, 1887, p. 291. Mr. Charles Dury, of Avondale, Cincinnati, O., informs me that he has in his collection an Anhinga brought from Sault Ste. Marie, Mich., by Mr. Roach, who obtained it from the man who shot it. This is indeed very much out of its range.

VII. FAMILY PHALACROCORACIDÆ. CORMORANTS.

Character same as family.

PHALACROCORAX. 10

10. GENUS PHALACROCORAX BRISSON.

*a*¹. Tail feathers 12; breeding plumage with superciliary crests black.

*b*¹. Length 30.00 or more.

P. dilophus (Sw. & Rich.). 21

*b*². Length less than 30.00.

P. dilophus floridanus Aud. 22

Subgenus PHALACROCORAX.

21. (120.) **Phalacrocorax dilophus** (Sw. & Rich.).

Double-crested Cormorant.

Adult.—"Tail of twelve feathers; gular sac convex or nearly straight edged behind. Glossy greenish-black; feathers of the back and wings coppery-gray, black shafted, black edged;" curly black crests on side of head. "In the breeding season other filamentous white ones over the eyes and along the sides of the neck. Gular sac and lores orange."

Immature.—Above, grayish-brown; below, brownish; no crests or other decorative feathers on head. (Ridgw.)

Length, 29.00 to 33.50; wing, 12.00-13.00; bill, 2.25.

RANGE.—Eastern North America, from the Gulf of Mexico to Manitoba. Breeds from Dakota and Maine, formerly from Ohio and Iowa, northward. Winters from Maine and southern Illinois southward.

Nest, in trees or on cliffs, of sticks, etc. *Eggs*, 2-5, pale bluish-green, more or less encrusted with chalky; 2.52 by 1.59.

Regular migrant, more or less common along the larger streams. Doubtless occasionally winter resident in southern part of the State. It must be that most of the cormorants reported from our State belong to this species. While but few of the specimens reported have been preserved, and consequently are not accessible for verification, those examined have generally proven to belong to this species. At Brookville I have noted it as early as February 2 (1883) and as late as April 16 (1881) in spring, and from September (1879) to Nov. 19 (1880) in fall. (Langdon Journ. Cin. Soc. Nat. Hist., July, 1880, p. 127.) They are most numerous with us in the spring, in April, and in the fall, in October. The fall of 1880 they were unusually numerous on the White-water River. One flock of fourteen was seen, from which several were shot, one of which is now in my collection. Mr. E. R. Quick also secured others, one of which he placed in the collection of Dr. F. W. Langdon. Farther northward in the State they remain later in spring than they do with us. Mr. H. K. Coale noted it from Lowell, Ind., in April, 1883, and Mr. B. T. Gault from English Lake, May 30, 1880. Mr. J. E. Beasley took one at Indianapolis, May 8, 1858. Prof. Cooke notes that Dr. Ezra S. Holmes, of Grand Rapids, Mich., has a male which he took in northern Indiana, near the Michigan line (Birds of Michigan, p. 36). In the fall I have no Indiana record earlier than September. Prof. Cooke (loc. cit.) records it from Pine Lake, Michigan, in August, 1893. Messrs. Ulrey and Wallace note a male and female taken at Long Lake, Ind., Nov. 15, 1890 (Proc. Ind. Acad. Sci., 1895, p. 149), and Mr. Jesse Earle informs me of one shot Nov. 28, 1895, on Big Walnut Creek, Putnam County, Ind. Mr. Ruthven Deane reports seeing a Cormorant of this species at English Lake, June 5, 1892. In November, 1896, Mr. W. O. Wallace made a trip down the Wabash River. November 3 he took a female four miles below Wabash. He saw others at the following points: One near Logansport, one near Vincennes, and one near Mt. Carmel, Ill.

I do not know that it ever breeds in Indiana, but Dr. Wheaton (Birds of Ohio, p. 544) says it is said to have nested years ago at the Licking Reservoir. In the Ohio Valley they are known as "Water

Turkeys," and in the Northwest Territory they are called by the natives "Crow Duck." Although a sea bird, and breeding along the shores of the Atlantic from the southern borders of the British possessions on the west side, they nevertheless breed at some places in the interior of America. Formerly they were known to breed in Iowa, but perhaps none now nest south of some favorite lakes in Minnesota and Dakota. Prof. Macoun notes them as breeding abundantly in northwestern Canada, at Lake Winnipegosis, in 1881 (Thompson, *Birds of Manitoba*, p. 473). The food of Cormorants is fish. They may be seen along watercourses and about lakes during the migration, often singly, but many times from ten to a dozen together. To one unacquainted with them they appear as ducks with a peculiar manner of flight, but when they are seen to alight on the projecting limb of some tree that overhangs the water, it at once becomes apparent that the bird is something else.

22. (120a.) *Phalacrocorax dilophus floridanus* (AUD.).

Florida Cormorant.

Similar to the last species, but smaller. Length, 21.25-30.00; wing, 12.00; bill, 2.10.

RANGE.—Southeastern United States north to North Carolina, Ohio, Indiana and Illinois. Breeds north to Ohio.

Nest and Eggs.—Similar to those of last species.

The Florida Cormorant is a migrant and perhaps a rare summer resident in southern Indiana. A few may remain through the winter, when the weather is not too severe. Some years ago it was thought the Cormorant most commonly seen in the Ohio Valley was this species. In later years examination of specimens shows that the majority of occurrences are of the Double-crested Cormorant. Whether it or the present species was formerly the more common, I have no means of determining. The birds have been largely destroyed or forced to withdraw from this range. Prof. O. P. Jenkins found it as far up the Wabash River as Terre Haute. Dr. Stein met with it on the Lower Wabash. Mr. Robert Ridgway notes it as ranging up the Wabash River as far as Mt. Carmel, Ill. He thinks it is a summer resident and probably breeds in Knox and Gibson counties. I have the skull of a specimen taken near Brookville in 1877. Dr. F. W. Langdon notes it from the vicinity of Cincinnati (*Journ. Cin. Soc. Nat. Hist.*, I, 1879, p. 186). The same gentleman, in his observations on Cincinnati Birds, gives the following account, by Mr. Chas. Dury, of

their former abundance at St. Mary's Reservoir, in Ohio, which is probably not over twelve miles east of the Indiana line: "On the south side of the Reservoir, about seven miles from Celina, was the 'Water Turkey' Rookery. Here I used to shoot them, with the natives, who wanted them for their feathers; I have helped kill a boat-load.

"One season I climbed up to their nests and got a cap full of eggs. The nests were made of sticks and built in the forks of the branches. The trees (which were all dead) were mostly oaks, and covered with excrement. I found from two to four eggs or young to a nest. The young were queer little creatures—looked and felt like India rubber. The old birds flew around in clouds, and made their croaking notes, indicative of their displeasure at my presence. Some of the trees had ten or twelve nests in them. As the timber has rotted and blown down, the birds have become less and less numerous.

"The above circumstances occurred during the month of June, 1867, since when, as Mr. Dury states, these birds have rapidly decreased in numbers. The many specimens examined by him were, without exception, var. *floridanus*."

Dr. Langdon found a single specimen floating on the Reservoir in October, 1874.

VIII. FAMILY PELECANIDÆ. PELICANS.

Characters same as family.

PELECANUS. 11

II. GENUS PELECANUS LINNÆUS.

*a*¹. Tail feathers 24; lower jaw densely feathered. Subgenus *Cytopelecanus*. Reich.

*b*¹. Color, white.

P. erythrorhynchos Gmel. 23

23. (125) *Pelecanus erythrorhynchos* GMEL.

American White Pelican.

"White; occiput and breast, yellow; primaries, their coverts, bastard quills and many secondaries, black; bill, sac, lores and feet, yellow." (Wheaton.)

Length, 53.50-64.00; wing, 22.25-25.25; bill, 11.30-15.00.

RANGE.—North America, from Guatemala to latitude 61 degrees north in the interior. Rare on the Atlantic coast. Breeds, locally, from Great Salt Lake, Utah, northward.

Nest, a mound of earth with a depression in the top. *Eggs*, 2-4; dull chalky-white; 3.45 by 2.30.

Rare migrant. Almost every year one or more are noted from some place in the State, yet few are the persons who ever saw one alive. Dr. Rufus Haymond reported it from Franklin County. Mr. E. J. Chansler writes me of the occurrence of these birds in large numbers in Knox County in 1850. One was killed near Swan Pond in the spring

of 1890. Mr. Robert Ridgway has also observed it in Knox and Gibson counties. Mr. C. A. Stockbridge, in Allen County; Mr. Charles Dury, from "Swan Lake," and Dr. Vernon Gould, from Fulton County. Prof. B. W. Evermann notes its occurrence in Montgomery County, and the capture of a specimen by Mr. W. W. Black, in Carroll County, in the spring of 1881 (*The Auk*, October, 1888, p. 346). Mr. F. M. Noe gives an account of a specimen taken at New Castle May 20, 1892, in the *Ornithologist and Oologist*, 1892, Vol. XVII, p. 123. A White Pelican was killed May 25, 1892, near Bloomfield, Greene County. One was taken on the Wabash River, near Lafayette, Sept. 29, 1895 (L. A. and C. D. Test). Mr. W. B. Van Gorder reports a specimen taken at Rome City in the spring of 1896. It is now in the possession of Mr. William Williams. Mr. F. M. Woodruff informs me that two of these birds were seen in the vicinity of Miller's in the fall of 1896, and that they remained there several days. Mr. F. M. Noe wrote me that he received a White Pelican which was killed near Connersville, May 3, 1897. He says it was reported to have been seen in that vicinity for several days. Mr. T. H. Ball says years ago they were of regular occurrence at Cedar Lake, Lake County. They are usually seen as they go northward in the spring, in May, and on their way southward, in September or October. We are out of the line of their migrations, hence see comparatively few of them, and those observed are generally single birds. The direct line of movement to their breeding grounds is to the west of the Mississippi River. There they migrate in flocks, and are much more often seen. Their breeding ground is chiefly north of the United States, where about many of the lakes of British America they breed, as they also do on the islands of Great Salt Lake, Utah. Ordinarily to the westward of the Mississippi River the greater number pass north in April. It would therefore seem that those which come to us are among the later migrants.

IX. FAMILY FREGATIDÆ. MAN-O'-WAR BIRDS

Characters same as family.

FREGATA. 12

12. GENUS FREGATA BRISSON.

♂. Black; shoulders of male lustrous.

F. aquila Linn. 24

24. (128.) **Fregata aquila** LINN.

Man-o'-War Bird.

Adult Male.—Tail deeply forked, entirely black, more or less glossy above. *Adult Female*.—Similar, but duller and browner; breast and sides whitish. *Immature*.—Head, neck, breast and belly, white; rest of plumage like that of female.

Length, 37.50-41.00; wing, 22.00-27.10; tail, 14.25-19.25; depth of fork, about half its length; bill, 4.25-5.15.

RANGE.—Tropical and sub-tropical regions; north to Florida, Texas and California; accidentally to Nova Scotia, Indiana and Kansas.

Nest, of sticks in bushes or on rock near the sea. Egg, 1; chalky-white; 2.62 by 1.75.

Accidental visitor. This graceful bird of the tropic seas rarely wanders far inland. Along the Gulf of Mexico it is a resident. Only once, so far as we know, has it been identified in Indiana. In the fall of 1896 I saw, in the office of Mr. J. E. Beasley, the well-known taxidermist, at Lebanon, Ind., a nicely mounted specimen of a young male of this species. I learned it was killed near Shelbyville, Ind., July 14, 1896, by Mr. W. S. Patterson, and came into Mr. Beasley's hands for preservation the next day. I took the following measurements from the mounted specimen: Length, 36.00; wing, 24.00; tail, 16.00; depth of fork, 7.00; bill, 4.25. There is only one other record for the Ohio Valley. In the spring of 1880 a specimen was taken in Franklin County, O., and is now in the possession of Dr. Renshaw, of Sugar Grove, O. (Davie., Nests and Eggs, N. A. Birds, pp. 59, 60). There are two other records that are equally remarkable in showing the inland wanderings of this species. In the Milwaukee Public Museum is one of these birds, which was killed in the vicinity of Humboldt, Wis., a few miles north of Milwaukee, in August, 1880. In the same month (August 16, 1880) one was killed with a stone while sitting on a tree in Osborne County, Kan. It was mounted, but track has been lost of the specimen. However, a photograph was taken, which serves to verify the record (Bird Migration in the Miss. Valley. Cooke, p. 60).

D. ORDER ANSERES. DUCKS AND GEESE.

X. FAMILY ANATIDÆ. DUCKS AND GEESE.

a¹. Neck shorter than body.

aa¹. Space between eye and bill wholly or partly naked.

CAIRINA. 18a

aa². Space between eye and bill feathered.

b¹. Front of tarsus divided into more or less square plates; its length less than middle toe without claw; sexes unlike.

c¹. Bill narrow, long; apparently with teeth. Subfamily MERGINÆ.

d¹. Processes of mandibles conspicuously tooth-like, pointing backwards at tips.

MERGANSER. 13

d². Processes of mandibles short, not pointing backwards at tips.

LOPHODYTES. 14

- c². Bill broad; lower mandible with a very distinct series of lamellæ along the side, besides the series along the upper edge.

Subfamily ANATINÆ.

- e¹. Hind toe without lobe or flap.

f¹. Bill not spoon shaped; scarcely widened towards the tip.

g¹. Tail feathers narrow, rather pointed; no crest.

h¹. Tail not pointed, its middle feathers not unusually long in male; speculum green, violet or white. ANAS. 15

h². Tail pointed; its middle feathers much lengthened in the male; female with tail much shorter; speculum violet.

DAFILA. 17

g². Tail feathers broad, rounded at tip; male with a high crest.

AIX. 18

f². Bill spoon shaped, narrow at base, very broad towards tip.

SPATULA. 16

- e². Hind toe with a broad lobe or flap.

i¹. Tail feathers with bases scarcely concealed by short coverts; tail feathers narrow and stiff.

j¹. Outer toe longer than middle toe; nail of bill small, bent backward beneath the tip of upper mandible.

ERISMATURA. 24

j². Outer toe shorter than middle toe; nail of bill normal.

NOMONYX.

i². Tail feathers with their bases well hidden by their coverts.

k¹. Feathering on lores or forehead not reaching beyond posterior border of nostril.

l¹. Graduation of tail less than length of bill from nostril.

AYTHYA. 19

l². Graduation of tail more than length of bill from nostril.

m¹. Bill ordinary, not swollen; having no appendage on edge at base of upper mandible.

n¹. Wing less than seven inches long; eyes brown.

CHARITONETTA. 21

n². Wing over seven inches long.

o¹. Nostril in middle of bill, or nearer tip than base; eyes yellow. GLAUCIONETTA. 20

o². Nostril nearer the base than tip of bill; male with long tail. C'LANGULA. 22

m². Bill not ordinary, swollen or else appendaged at base, or on sides.

p¹. Bill swollen at base. OIDEZIA. 23

p². Bill not swollen at base, but appendaged.

q¹. Bill appendaged with a lobe on each side near base; speculum violet.

HISTRIONICUS.

q². Bill with a leathery expansion on sides of upper mandible; cheeks bristly; speculum white. CAMPTOLAIMUS.

k². Feathering on forehead or lores extending to or beyond nostril; bill swollen at base. SOMATERIA.

*b*². Tarsus marked with a network of lines over its whole surface; meshes slightly larger in front; its length not less than that of middle toe without claw; sexes alike.

*c*¹. Cutting edge of upper mandible nearly straight; its serrations scarcely visible from side, except near angle of mouth; head, bill and feet mostly black.

BRANTA. 27

*c*². Cutting edge of upper mandible concave or sinuate; its serrations plainly visible from side for nearly its whole length; bill and feet pale.

*a*¹. Bill very stout; its depth at base more than half the length of upper mandible; color largely white. CHEN. 25

*a*². Bill smaller, more depressed; its depth at base not half the length of upper mandible; color not white.

ANSER. 26

*a*². Neck as long as or longer than body; lores partly naked.

Subfamily CYGNINÆ SWANS.

*c*¹. Color white; bill and feet black, in adult; grayish, head and neck brownish; bill and feet light, in young.

OLOR. 28

SUBFAMILY MERGINÆ. MERGANSERS.

13. GENUS MERGANSER BRISSON.

*a*¹. Nostril nearer middle of bill than base. **M. americanus** (CASS.). 25

*a*². Nostril near base of bill. **M. serrator** (Linn.). 26

25. (129.) **Merganser americanus** (CASS.).

American Merganser.

Synonyms, FISH DUCK, GOOSANDER.

Nostrils situated near the middle of the upper mandible; frontal feathers extending farther forward than those on lateral base of bill.

Adult Male.—Head and most of neck, greenish-black; head slightly crested; chest and other lower parts, creamy white or pale salmon-color.

Adult Female.—Head and neck, reddish (chin and throat white), the occiput with a full crest of lengthened feathers; above, chiefly bluish-gray.

Male; length, about 27.00; wing, 10.50-11.25; bill, 1.90-2.20; tarsus, 1.90-2.00. Female smaller.

RANGE.—North America generally. Breeds from latitude of Minnesota and Michigan northward; winters from Kansas, Indiana and Maine southward.

Nest, in holes in trees and cliffs. *Eggs*, 6-10; creamy buff; 2.65 by 1.75.

Common migrant and winter resident. They vary in numbers with the winters. The more open the winter the greater the number. Even in the coldest winters they may be found where the water is not frozen. On Lake Michigan it is one of the commonest ducks during the winter months. At Miller's, Ind., they were common Dec. 17, 1895. Jan. 14, 1897, four were seen (J. G. Parker, Jr.). In 1891, Feb. 14 and 15, there were a few flocks and pairs seen at English Lake, Ind. On Feb. 12 some 200 were seen, and five were shot. They were about more or less all winter. February 27 and 28, 1892, there were many flocks on the river (Kankakee). Several were shot. They were observed during the winter whenever they could find open water. (Ruthven Deane.)

The winter of 1889-90 they remained on the Whitewater all winter and were noticed commonly from Feb. 11 on. The winter of 1896-7 they were found at Brookville, Dec. 6, and, from reports, were seen off and on all winter.

In the early spring this is the most common duck upon the creeks and smaller streams. They increase in numbers noticeably in February or March, and, as the weather becomes warmer, begin to pass on north, usually the middle of March. Most have gone by the middle or last of April. Mr. Jesse Earlle notes one at Greencastle, May 7, 1892, an unusually late date for southern Indiana. Occasionally some may spend the summer among our northern lakes, but I do not know that they breed with us. They breed, however, in northern Michigan, and from that latitude northward throughout Manitoba and adjacent parts of Canada. It is rare on Alaskan coasts. In Manitoba, Mr. E. E. Thompson says they frequent only running water. This duck feeds almost, if not altogether, on fish; therefore its flesh is fishy and unpalatable. In the fall they return to us in October and November, but are not nearly so common or so noticeable as in the spring.

26. (130.) *Merganser serrator* (LINN.).

Red-breasted Merganser.

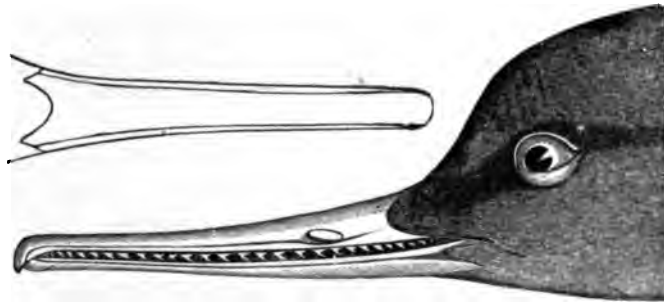
Nostrils situated near the base of the maxilla; feathers on lateral base of bill extending farther forward than those on the forehead. *Adult Male*.—Head, dull greenish-black, the occiput with a long, pointed crest of narrow feathers; neck and sides of the chest, dull buff, or light cinnamon, streaked with black; other lower parts mainly white. *Adult Female*.—Very similar in color to last species.

Length, about 20.00-25.00; wing, 8.60-9.00; culmen, 2.50; tarsus, 1.80-1.90.

RANGE.—Northern portions of northern hemisphere; in America, it breeds from northern Illinois, Michigan and that latitude northward. It winters from its southern breeding limit southward.

Nest, on ground, beneath projecting rock or other object, of moss or leaves, lined with down. **Eggs**, 6-12; yellowish or reddish-drab; 2.57 by 1.73.

Migrant and winter resident throughout the State. Generally rare, but occasionally, on the larger bodies of water, rather common. Mr. J. G. Parker, Jr., notes that it is an occasional winter visitor on Lake Michigan. Mr. Ruthven Deane says they remain at English Lake,



Head of a Red-breasted Merganser, with outline of bill from above. Natural size.

Ind., as long as there is open water. On the 22d of November, 1891, he found them abundant there. Over the southern part of the State they are found in winter, as is the last species, except that they are much fewer in number. They go northward as the rivers are freed from ice in early spring. The records generally show them moving in March. During that month they may be found on the streams of southern and middle Indiana; and in March and April they frequent the marshes of the northern part of the State. They go northward earlier than the last mentioned species, or at least they do not seem to linger as does that form. They are by far the rarest of the fish ducks with us. Returning from their breeding places, they are found about the marshes in the northern part of the State, sometimes quite abundantly, but generally they are rare. In October or November, usually, they occur in small numbers, one or two to four or five together, but sometimes quite large flocks are met with. Mr. Parker informs me that April 10, 1897, a beautiful male Red-breasted Merganser was killed on the Kan-

kakee River, near Kouts, Ind. This he found hanging on the side of a hunter's cabin on April 15. That day another hunter brought to him a female, which he thought was the mate of the one previously killed.

It has not been found breeding in Indiana. Mr. E. W. Nelson (Birds of N. E. Illinois, p. 144) notes it as a rare summer resident, and says it frequents small, reedy lakes, and nests upon old muskrat houses. Mr. C. L. Cass informs me that he found nests of this Merganser near Cross Village, Mich. (where it breeds commonly), in the summers of 1896 and 1897, and adds that Mr. Ed. Van Winkle, of Van's Harbor, has also found this duck breeding. Mr. S. L. White reports having found a nest on Round Island, near Mackinac Island. It was located under a low cedar near the water's edge, and contained nine eggs (Cook, Birds of Michigan, p. 38).

Prof. Macoun says, in Manitoba, where this duck commonly breeds, both it and the Hooded Merganser feed largely on vegetable food, and are quite edible (E. E. Thompson, Birds of Manitoba, p. 474).

15. GENUS LOPHODYTES REICHENBACH.

♂¹. Speculum white, with two dark bars.

L. cucullatus (Linn.). 27

***27. (131.) *Lophodytes cucullatus* (LINN.).**

Hooded Merganser.

Nostrils near the base of the maxilla; frontal feathers, reaching beyond those on sides of bill; a compact, erect semi-circular, laterally compressed crest in the male. Smaller and less rounded in the female. *Male*.—Black, including two crescents in front of wing, and bar across speculum; under parts, center of crest, speculum, and stripes on tertials, white; sides, chestnut, black-barred. *Female*.—Smaller; head and neck, brown; chin whitish; back and sides, dark-brown, the feathers with paler edges; white on the wing less; bill, reddish at base below.

Length, 17.50-19.00; wing, 7.50-7.90; culmen, 1.50; tarsus, 1.25-1.30.

RANGE.—North America, generally, south to Mexico and Cuba, breeding nearly throughout its range.

Nest, in hollow trees or stumps, made of leaves or grasses, lined with down. *Eggs*, 6-18; pearly-white; 2.15 by 1.72.

Very abundant migrant, less common winter resident, and locally resident in some numbers. Throughout the State the Hooded Merganser may be found in winter, the more numerous the more open the

winters, and always attracted to the open water, so that in the most severe winters they are most to be observed on the rapid streams of southern Indiana, where ripples and rapids are about the only places they can find at which to congregate. Perhaps they are most numerous on Lake Michigan at this season, but at English Lake, Ind., and other large lakes they remain until the water freezes over. In the latter part of February in some years, and always by early March, their numbers begin to increase, and the spring migration has begun. They pass northward rapidly, and most of them are gone by the latter part of March. But few records are made for April, except in breeding localities; occasionally, however, there are belated migrants noted as late as May. Through April they pair and seek a home.

They breed in suitable localities throughout the State. Owing to the scarcity of such localities in southern Indiana but few have been reported from that section. Mr. Robert Ridgway found them more numerous than the Wood Duck, and breeding in hollow trees, in Monteur's Pond, Knox County, in the spring of 1881 (Bull. Nutt. Orn. Club., Vol. VII, Jan. 1, 1882, p. 22). I feel quite confident that it formerly bred in a swamp in which there was much timber, on the west fork of Whitewater River, about four miles from Brookville. Prof. B. W. Evermann, in 1888, informed me of its breeding in Vigo County, and the same authority notes its breeding in Carroll County, where he saw young in July (The Auk, October, 1888, p. 346). Mr. F. E. Bell informs me of its breeding in Wabash County. Mr. C. E. Aiken says it breeds commonly on the Kankakee River, and Mr. J. G. Parker, Jr., has recently written me that quite a few breed on that river in the vicinity of Kouts, Ind.

The migrants return in October and November, and linger as long as the waters are open and food is abundant. The first "freeze up" starts them southward.

SUBFAMILY ANATINÆ RIVER DUCKS.

15. GENUS *ANAS* LINNÆUS.

*a*¹. Culmen longer than middle toe without claw.

*b*¹. Wing over 8, speculum violet, bordered with black. Subgenus *Anas*.

*c*¹. With white on the outer surface of wing; sexes unlike; colors of male varied and brilliant; female plainer. *A. boschas* Linn. 28

*c*². No white on outer surface of wing, but linings of wing white; sexes alike; colors plain. *A. obscura* Gmel. 29

*b*². Wing less than 8, speculum green. Subgenus *Querquedula* Stephens.

*d*¹. Wing coverts sky-blue.

*e*¹. Wing 7. or more.

A. discors Linn. 34

*d*². Wing with no blue; bill very narrow. Subgenus *Nettion* Kaup.

*f*¹. White crescent on side of body in front of wing.

A. carolinensis Gmel. 33

*a*². Culmen shorter than middle toe without claw.

*g*¹. Bill not shorter than head. Subgenus *Chaulelasmus* Bonaparte.

*h*¹. Speculum white.

A. strepera Linn. 30

*g*². Bill shorter than head; crown and belly white.

Subgenus *Mareca* Stephens.

*i*¹. Head and neck plain rufous.

A. penelope Linn. 31

*i*². Head and neck grayish; sides of head with broad patch of green.

A. americana Gmel. 32

***28. (132.) *Anas boschas* LINN.**

Mallard.

Adult Male.—Four middle tail feathers strongly recurved; head and neck brilliant velvety-green; chest, rich chestnut, with a white collar between it and the green of the neck; speculum, rich metallic violet, bounded anteriorly by a black bar, this preceded by a white one, and posteriorly by a black subterminal and white terminal band. *Adult Female and Male in Breeding Season*.—Wings as in the above; elsewhere variegated with dusky and ochraceous, the former on the centers of the feathers, and predominating on the upper parts; the latter on the borders, and prevailing beneath.

Length, about 20.00-21.50; wing, 10.25-11.50; culmen, 2.00-2.35; tarsus, 1.50-1.80.

RANGE.—Northern hemisphere; in North America, generally distributed; in the interior breeding from Indiana, Iowa, and, on the coast, from Labrador, northward. Winters from Indiana, Iowa, and Delaware southward to Panama and Cuba.

Nest, generally on ground. *Eggs*, 6-12; pale, dull green, or greenish white; 2.25 by 1.60.

Abundant migrant; winter resident in varying numbers, and locally, particularly in the northern part of the State, resident in some numbers.

Some winters, when the weather is severe and the waters are mostly frozen over, the Mallard is scarce in Indiana. Occasionally two or more such winters succeed each other, and then for more than one winter these ducks are rare. Often, however, they remain, and, upon the larger streams, may be found in some numbers through the entire severe season. Open water and food are the only requirements to make them winter residents.

Their spring movements vary with conditions. If the season opens early, they begin to migrate early in February. On the contrary, some

seasons, when the winter holds late, there is no apparent movement until the middle of March. The migrants do not remain long. Outside of breeding localities, they are not often reported after early April. A few, however, seem to linger well through the month.

Sometimes, in the midst of the migration, the unexpected happens. A cold snap comes down suddenly upon the waters alive with wild fowl, and they are forced to change their habits. From swimmers they become skaters. Mr. Ruthven Deane informs me that March 13, 1892, a rough, cold day, when boatmen were compelled to break ice over a mile to get their boat through, boat, paddles, and men were coated with ice, and English Lake marshes were mostly ice bound, there were thousands of ducks and geese sitting around in droves on the ice. The same gentleman has kindly furnished me with the following data from the records of some of the shooting clubs at that lake. In 1881, first Mallard shot, February 10; in 1886, first shot, March 14; in 1887, first shot, March 6; 1892, January 1. The last Mallard shot each of the following years is also given: 1881, December 7; 1886, December 11; 1886, November 25; 1889, December 24.

They pair early. Even in February they are often noticed mated, and by the middle of March some years, seem mostly paired. Soon after pairing they seek a nesting place. The nest is usually placed on the ground, or in the grass, drift, or accumulated vegetation, though instances are reported where they have been found in hollow trees. Late in April the nests may begin to be found, with a complement of fresh eggs. Through May and into early June nests of eggs are to be seen, but the later ones are well incubated, and most of the birds have young by June 15. Mr. Deane informs me of one nest containing eleven eggs at English Lake, the week ending May 4, 1890, which was placed on a tussock of grass in an open meadow, and of another found the same week placed on the top of a large haycock. They were very numerous at English Lake, August 8, 1897. Evidently had bred in that vicinity. (Deane.) Mr. H. K. Coale informs me of having seen a brood of twelve at Davis' Station, Starke County, June 1, 1884. He caught several young the same day, ranging from one day to several days old. They have been reported as breeding in the following counties: Lake County (L. T. Meyer, J. G. Parker, Jr., C. E. Aiken); Starke (Ruthven Deane, Charles Dury, H. K. Coale); Knox (Robert Ridgway); Dekalb (H. W. McBride); Steuben (C. L. Cass); Laporte (C. L. Barber); Wabash (Ulrey and Wallace).

After breeding, the Mallards gather into small flocks, which unite as the numbers increase from the daily additions of old and young from the meadows and swamps. Then they keep in the marshes and more

quiet waterways until the young know how to fly. By the middle of July or first of August these flocks sometimes number 200 ducks. About the middle of August most of the ducks that breed with us disappear. Mr. Deane says some gunners are satisfied that they move north, and then return with others of their species a month later. I myself can not believe they go south so early, and we know that they leave our grounds.

The fall migrations begin soon after the middle of September. By the 25th, usually, many small flocks are observed. Frequently good Mallard shooting may be had in September, but the main flight is during October. Large numbers, however, remain until severe weather begins, and then suddenly leave.

Mr. Parker informs me that thousands are shot every year about the lakes in Lake County. Their numbers are rapidly diminishing as swamps are drained, marshes reclaimed, and lakes reduced in size. Cities are built upon the shores of their choicest resting places, and the city people seek their favorite breeding grounds for pleasure or for rest. The dry summers which have prevailed during the past six or eight years have in many ways had an effect upon both plant and animal life. The effect upon birds has been noticeable in many ways. The lack of rain in the summer and fall of 1891 was very unusual. Small water courses, swamps, ponds, and much of the area of some of our lakes became dry. Writing under date of November 9, 1891, Mr. Ruthven Deane says, at English Lake, the greater part of the Lake is an exposed mud flat. I have seen Pintails and Mallards alight in the soft mud and wallow around like so many gulls.

The Mallard is the ancestor of the common domestic duck. Sometimes there are found hybrids between the Mallard and the Pintail. Mr. Deane writes me of a fine specimen of this kind taken several years ago at English Lake. He says he has seen many of these hybrids, and as a rule the plumage is quite evenly divided.

29. (183.) *Anas obscura* GMEL.

Black Duck.

Synonym, *Dusky Duck*.

Male.—Prevailing color dusky, the feathers bordered with dull ochraceous; head and neck, dull buff, everywhere streaked with dusky; no black at base of the bill; speculum usually deep violet, resembling female Mallard, but distinguished from it by the absence of white on wing. *Female*.—Smaller; similar.

Length, about 20.00-21.50; wing, 10.25-11.50; culmen, 2.00-2.35; tarsus, 1.50-1.80.

RANGE.—Eastern North America, west to Mississippi Valley, north to Labrador, breeding southward to the northern parts of the United States, northern Illinois and Iowa. Winters south to Greater Antilles.

Nest, usually on ground. *Eggs*, 6-12; buff or greenish buff; 2.30 by 1.70.

Not common migrant; occasional winter and rare summer resident.

This is an eastern species which reaches in Indiana, almost the western limit of its range. It has been noted by Mr. J. G. Parker, Jr., at Kouts, Ind., December 10, 1896. Mr. Ruthven Deane reported it from English Lake, February 14 and 15, 1891. The greatest numbers are reported in March, while migrating. It is rare in Franklin County, and has been reported in the following counties: Carroll (Prof. B. W. Evermann); Lake (Meyer, Parker, Aiken); Starke (Dury, Deane); Laporte (J. W. Byrkit); Allen (C. A. Stockbridge); Dekalb (Mrs. J. D. Hine); Putnam (J. F. Clearwaters); Decatur (Prof. W. P. Shannon); Kouts (J. G. Parker, Jr.); Wabash (Ulrey and Wallace).

Mr. Parker has found them at Kouts on the Kankakee River, apparently paired, April 15, 1892, and Mr. Deane noted a pair in the marsh at English Lake as late as May 10, 1891. They are usually paired by the latter part of March. While I have no account of its breeding in Indiana, I have no doubt it will be found to do so. Mr. E. W. Nelson found one or two pairs nesting on the Calumet marshes (Birds of Northeastern Illinois, p. 159). Mr. L. T. Meyer says it probably breeds in Lake County, and Mrs. Jane L. Hine reports it a summer resident in Dekalb County.

30. (135.) *Anas strepera* LINN.

Gadwall.

Adult Male.—Head and neck pale brownish or whitish, thickly speckled with black; top of head sometimes plain light brown; crop varied with crescentic bars of white and black, the latter predominating; sides, back, and scapulars finely undulated with slate color and white; middle wing coverts, chestnut; greater coverts, black; speculum, white; crissum and upper tail coverts, velvety black.

Adult Male in Breeding Season.—Similar to the winter male, but colors duller; crown dusky; rump and breast tinged with rusty, and under parts more spotted with dusky. *Adult Female.*—Colors chiefly brownish dusky and brownish white, in longitudinal streaks on head

and neck, and in irregular transverse spots, and bars on other portions, the dusky predominating above, the white below.

Length, 19.25-21.75; wing, 10.25-11.00; culmen, 1.60-1.75; tarsus, 1.75-1.80. Female smaller.

RANGE.—Nearly cosmopolitan. In North America, breeds chiefly within the United States. Winters from southern Illinois and Virginia south to Gulf of Mexico.

Nest, on ground. *Eggs*, 8-12, pale buff; 2.09 by 1.57.

Rare migrant. There are but few records of its occurrence in Indiana. Dr. Rufus Haymond and Mr. E. R. Quick note it from Franklin County, and May 4, 1890, Mr. Ruthven Deane informed me that several pairs were seen at English Lake. Mr. J. G. Parker, Jr., informs me that several years ago he collected one in a "pond hole" on the east side of Calumet Lake, Cook County, Illinois, in September.

Dr. F. Stein identified it in the Lower Wabash Valley. It sometimes remains in Illinois in mild winters (Cook, Bird Migration in Mississippi Valley). The Gadwall breeds throughout its range.

Subgenus *MARECA* Stephens.

31. (136) *Anas penelope* LINN.

Widgeon.

Synonym, EUROPEAN WIDGEON.

Adult Male.—Forehead white; posterior half of middle wing covert region white, forming a large patch of this color; abdomen immaculate white; speculum velvety black, with or without green; head and neck plain rufous; ground color of dorsal region, sides and flanks whitish.

Adult Female.—Head and neck pale rusty, speckled and barred with dusky, especially on crown; upper parts dusky brown, the feathers edged and more or less barred with pale brown and whitish; white patch on wing coverts, merely indicated by white tips to feathers; speculum grayish brown and dull rufous, or fulvous; rest of lower parts white, the lower tail coverts barred with brown.

Length, 18.00-20.00; wing, 10.00-11.00; culmen, 1.35-1.45; tarsus, 1.45-1.65.

RANGE.—Northern part of the old world, frequent in Alaska. In North America, breeds in the Aleutian Islands, and occurs frequently in the eastern United States, west to Indiana, Illinois, and Wisconsin, and occasionally in California.

Eggs, 5-8; pale buff; 2.23 by 1.53.

Accidental visitor.

The European Widgeon has been taken in a number of places in North America. Two records of its occurrence in Illinois are given by Mr. E. W. Nelson, and the late Dr. P. R. Hoy reported one instance in Wisconsin. To Mr. Ruthven Deane belongs the credit of obtaining four records of its capture in Indiana. All were taken at English Lake. The first specimen in order of time known to have been taken in the State is in the collection of Dr. Nicholas Rowe, of "The American Field," Chicago, Ill. It was killed at English Lake in 1881 or 1882. (The Auk, XII, 1895, p. 292.) April 13, 1893, Mr. Landon Hoyt, of Chicago, Ill., took a specimen on the Kankakee River at English Lake, which is now in his possession. It was in company with a flock of Baldpates (*Anas americana*.) The Auk, XII, 1895, p. 179.) April 7, 1895, Mr. J. F. Barrell shot a young male from a flock of Baldpates in the same vicinity. It is now in Mr. Deane's collection. (The Auk, XII, 1895, p. 292.) The fourth specimen, a fine adult male, was killed at English Lake by Mr. John E. Earle, of Hinsdale, Ill., March 23, 1896. It was flying with a small flock of Baldpates when shot. The specimen is in Mr. Earle's collection. This is the eighth record for the interior of North America. (The Auk, XIII, 1896, p. 255.) The above records are all for the spring, and, so far as noted, they were in company with their American relative, the Baldpate.

***32. (137.) *Anas americana* Gmel.**

Baldpate.

Synonym, AMERICAN WIDGEON.

Adult Male.—Forehead white; head and neck whitish, speckled with black, and with a dark metallic green space on the side of the occiput (sometimes continued down the nape); posterior half of the middle wing covert region white, forming a large patch of this color; abdomen immaculate white; speculum velvety-black, with or without green; ground color of the dorsal region, sides, and flanks vinaceous or pinkish cinnamon. *Adult Female*.—Head and neck dull whitish, streaked with dusky; crop, sides and flanks dull vinaceous; upper parts dusky grayish-brown, irregularly and coarsely barred with dull white or buffy; smaller wing coverts, dull dark grayish, tipped and edged with white.

Length, 18.00-22.00; wing, 10.25-11.00; bill, 1.30-1.50; tarsus, 1.45-1.65.

RANGE.—North America, from the Arctic Ocean south, in winter, to Guatemala and Cuba. Breeds chiefly north of the United States; occasionally breeding from Indiana and Minnesota north, and rarely as far south as Texas.

Nest, on ground in marshes. *Eggs*, 8-13; pale buff; 2.06 by 1.48.

Common migrant, and rare summer resident in the northern part of the State.

In the southern part of the State they pass rapidly through during the migrations. Sometimes the advance guard is seen as early as the latter part of February, but generally they are not seen until the early part to the middle of March. I have never observed it at Brookville later than March 21 (1888). Prof. B. W. Evermann has noted it in Vigo County as late as March 26 (1888). About the middle of March they appear upon the rivers, lakes, and marshes of the northern part of the State. Occasionally they are seen earlier. Mr. H. W. McBride noted two in Dekalb County, February 26, 1890. Mr. Ruthven Deane informs me that the first Baldpate was shot at English Lake, March 15, 1886, and March 12, 1887. Generally they are seen in small flocks of four to a dozen the latter part of March and until late in April, when the greater number leave for the north. Mr. Deane noted a number at English Lake May 4, 1890, and saw a male at the same place May 10, 1891. It breeds in the northern part of the State. Mr. H. W. McBride saw a female Widgeon with thirteen young just hatched at Hogback Lake, Steuben County, in May 1889. When he pursued her in a boat all the young ones got on her back, and she swam away with them. Mr. Ruthven Deane writes me that a female Widgeon, accompanied by thirteen young, was seen at English Lake the summer of 1897. He thinks it was probably crippled, and unable to go farther north. Most of them, however, breed farther northward, and return in October, though quite a number were seen at English Lake, September 25, 1889 (Deane). Through October they are quite common, passing southward at the end of the month or early in November. The Baldpate is a good table duck, and is usually in good condition. Therefore, it is esteemed by the sportsman. It is not a diver, like the Canvasback. So it is said in water where wild celery abounds the Baldpate awaits its rising with the choice root in its mouth, when it rushes forward and seizes the celery for itself. Mr. E. E. Thompson notes its breeding at Selkirk Settlements, Lake Manitoba, and Qu' Appelle (Birds of Manitoba, p. 476). In Alaska it is not common, but breeds in the marshy flats bordering Bering Sea (Nelson, Nat. His. Coll. in Alaska, p. 68).

Subgenus *NETTION* Kaup.**33. (139) *Anas carolinensis* Gmel.****Green-winged Teal.**

Adult Male.—Head and upper neck chestnut, with a broad, glossy green band on each side, uniting and blackening on the nape; under parts white or whitish, the fore-breast with circular black spots; upper parts and flanks closely waved with blackish and white; a white crescent in front of the wing; crissum black, varied with white or creamy; speculum rich green, bordered in front with buffy tips of the greater coverts, behind with light tips of secondaries; no blue on the wing; bill, black; feet, gray. *Female*.—Differs in the head markings.

Length, 12.50-15.00; wing, 6.25-7.40; bill, 1.40-1.60; tarsus, 1.25.

RANGE.—In North America it breeds from Michigan and Minnesota north. Winters from Kansas, Indiana and that latitude south to Cuba and Honduras.

Nest, on ground in grass. *Eggs*, 6-12 (16-18, Dall.); buff or greenish; 1.75 by 1.30.

Common migrant; also, winter resident; may be locally a rare summer resident in northern part of the State.

Some winters the Green-winged Teal remains on Lake Michigan and the larger streams. With the first bird wave, usually in February, they may be noted returning from the south. In 1887 they were reported from Terre Haute, January 30, and next, February 5 (Evermann). From Vincennes in 1888, March 5; in 1889, February 20. They pass northward as the ice melts, but sometimes they reach the northern part of the State while the streams and lakes are still locked in ice. Mr. Ruthven Deane informs me the first were shot at English Lake March 18, 1886. Six were shot there March 17, 1889. A small flock seen February 27 and 28, 1892. Noted March 11, 1894. They do not linger long in the southern part of the State, and most of them must have left our northern marshes before April 1. I have taken it at Brookville April 3 (1883). It has been taken in Carroll County April 8 (1885, Evermann), and at Kouts April 12, 1895 (Parker).

It is not known to breed in the State. It formerly did to a limited extent in Illinois (Nelson's Birds N. E. Ill., p. 140), and is reported as breeding at St. Clair Flats and St. Joseph, Mich. (Cook, Birds of Mich., p. 39). Although Kennicott found it to be very rare on the Yukon, its breeding range extends far north. Turner found it common in Alaska and among the Aleutian Islands, where it is resident (Contr. to Nat. Hist. of Alaska, p. 132). Breeds com-

monly in the vicinity of Hudson's Bay and in Greenland. It nests on the ground, often at some distance from the water. Toward the latter part of September they begin to return from the north. They were abundant on the marshes at English Lake September 25, 1889. Mr. C. L. Cass noted them at Hilldale, Mich., September 19, 1894. They are usually much less numerous in fall than they are in spring. The fall of 1892 they were unusually abundant. They remain among the marshes and lakes until November, and often until the water is closed by ice. They are often seen when all other marsh ducks have left.

In winter it is common in the lower Mississippi Valley, and in the Gulf States. In the winter of 1879-80, I found it to be very abundant on the lakes of the Valley of Mexico.

Subgenus *QUERQUEDILA* Stephens.

***34. (140). *Anas discors* LINN.**

Blue-wing Teal.

Adult Male.—Head and neck blackish; darkest on the crown, usually with purplish iridescence; a white crescent in front of the eye; under parts thickly dark spotted; wing coverts sky blue, the greater white tipped; speculum green, white tipped; axillars and most under wing coverts white; scapulars striped with tawny and blue, or dark green; fore-back barred; rump and tail dark, plain; crissum black; bill black; feet, dusky yellow. *Adult Female*.—With head and neck altogether different; under parts much paler and obscurely spotted, but known by the wing marks.

Length, 14.50-16.00; wing, 7.00-7.50; bill, 1.40-1.65; tarsus, 1.20-1.30

RANGE.—North America chiefly, east of the Rocky Mountains. It breeds in southern Indiana, Illinois, and Ohio. Winters in southern Illinois and Virginia, southward to Ecuador.

Nest, on ground in grass. *Eggs*, 6-14; white or buffy; size, variable, average, 1.90 by 1.30.

Common migrant, and locally summer resident. In many respects the habits of this duck are directly the opposite of the last mentioned species. It is most abundant in spring; this one is not common at that season. It arrives in spring exceedingly early; this one very late. In fall it remains late; this species arrives early, and the bulk does not remain. It breeds far northward, and rarely within the United States. This species does not go so far north-

ward to breed, and it nests in some numbers as far southward as northern Indiana. Both it and the Green-wing Teal often nest at quite a distance from the water. The nest of both Teals is made upon the ground of grass and reeds, lined with down and feathers. It is said that the female covers the eggs with down when she leaves the nest.

Usually the Blue-wing Teal is not seen in spring until after the first of April. Ridgway notes it as being found in Illinois all the year. Prof. Cooke says it winters in southern Illinois. The earliest date at which I have seen it at Brookville is April 9 (1887). Occasionally, however, they appear earlier. The spring of 1892 seems to have been such a season. Some were shot on English Lake March 24 (Deane). Mr. Jerome Trombley reported two that year at Petersburg, Mich., March 20. Several others were noted in southern Michigan within the succeeding ten days. This date is earlier than any I have in Indiana.

Through the latter part of April they may be seen in suitable places in some numbers. Then they go north, where most of them breed. I have seen them at Brookville May 1 (1884).

Mr. Deane says they were abundant on English Lake May 4, 1890, and Prof. Evermann notes them as common on Lake Maxinkuckee May 11, 1885 (B. N. O. C., Oct., 1888, p. 346). After May 1 they may usually be noted in pairs, and toward the latter part of the month, and in June, nests with eggs may be found. A good many of these ducks remain through the summer on the Kankakee River, and I have no doubt that it breeds there much more commonly than we know, yet the numbers are growing less and less each year. In 1890, Mr. Deane tells me, a good many remained at English Lake and bred. Several nests were found. They were quite numerous at the same place August 8, 1897. Evidently they were birds bred in that vicinity (Deane). Mr. J. G. Parker, Jr., says a few pairs breed every year at Kouts, Porter County, and Liverpool, Lake County. It is reported as breeding in Lake County by Mr. C. E. Aiken. Mr. Robert Ridgway informs me of its breeding in Knox County and Gibson County. Mr. E. W. Nelson notes a nest of this species, found in Cook County, Ill., containing fourteen eggs (Birds of N. E. Ill., p. 140). In July they begin to collect into flocks of twenty to thirty individuals. During the early part of September they begin to return from the north. The numbers increase as the month wears away, until they become very numerous. They then afford good shooting, as many as 75 to 100 being killed by a party in a day. Late in September and early in October they leave the region of the Kankakee for the south. In 1886 the last of this species was killed at English Lake, on October 20. We expect them

in the Whitewater Valley about the first to the middle of the latter month, when they may be seen in flocks of 20 to 40. I have never observed them in Franklin County earlier than October 4, 1884. They fly with the flock bunched close together, and the rapidity of their flight and their rapid manœuvres, when the whole flock turns or whirls, as one bird, reminds me of the Wild Pigeon. When they alight they sit or swim very close to each other. For this reason the shooter, when they are very numerous, is enabled to make large bags of game. They are usually at that season in fine condition, and make excellent eating.

16. GENUS SPATULA BOIE.

♂¹. Speculum green, bordered by black and white. **S. clypeata** Linn. 35

***35. (142.) *Spatula clypeata* LINN.**

Shoveller.

Synonym, SPOONBILL.

Adult Male.—Bill much longer than head or foot, widening rapidly to the end, where it is twice as wide as at the base, with very numerous and prominent laminae; head and neck green; fore-breast white; belly purplish-chestnut; wing coverts blue; speculum green, bordered with black and white; some scapulars blue, others green, all white striped; bill blackish; feet red. **Adult Female.**—Known by bill and wings.

Length, 17.00-21.00; wing, 9.00-10.00; bill, 2.60-2.90; width of bill at end, 1.10-1.20; at base, .60; tarsus, 1.40-1.50.

RANGE.—Northern hemisphere. In North America, breeding from Alaska to Texas; not abundant on the Atlantic coast north of the Carolinas. Winters from southern Illinois to Guatemala and West Indies.

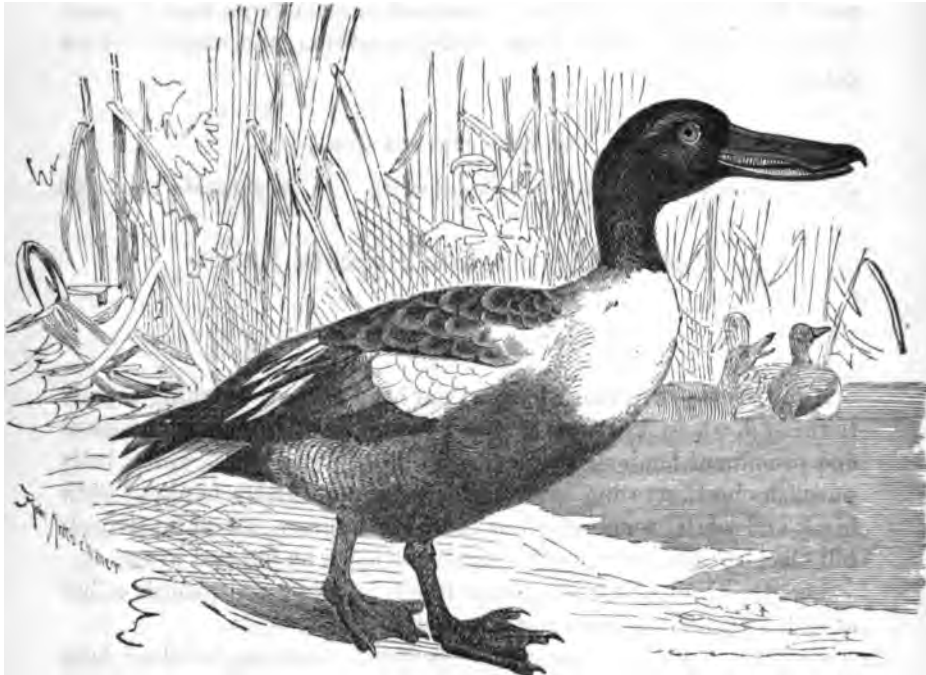
Nest, on ground. **Eggs.** 6-10; greenish-gray, 2.12 by 1.48.

Migrant; not uncommon; rare summer resident; possibly winter resident; some winters southward.

Prof. W. W. Cooke says this duck winters from southern Illinois southward. It may be found at that season, mild winters, in southern Indiana.

In 1887, Prof. B. W. Evermann found a single specimen at Terre Haute, February 26. That is the earliest record reported from the State. Usually they appear upon the Ohio and the rivers of southern Indiana by the first week in March. Decatur County, March 3, 1888 (E. L. Guthrie). About the middle of March they may be looked for

in the northern part of the State. The first shot at English Lake in 1886 was March 16. March 17, 1889, a number were seen. They were unusually fat for spring birds (Deane). Five or six were seen at Petersburg, Mich., March 12, 1893, and it was again noted March 14 (Jerome Trombley). They begin to pair about the 25th of March. The flocks dissolve, and the number of pairs increase throughout the



Shoveller.

early part of April. At that time they pass on to the northward in some numbers. Some remain until late April and even early May before leaving, and others remain to breed. Mr. Deane says, in 1889, Shovellers remained at English Lake until the first week in June.

They have been reported as breeding in Lake County (C. E. Aiken), and Starke County (Ruthven Deane). Mr. Deane tells me that May 4, 1890, Pearl Taylor found a nest of this duck at English Lake in a clump of willows, low down near the edge of a meadow. The nest contained nine fresh eggs, which are now in Mr. Deane's collection.

They have several times been reported late in May and through June. Therefore, it is reasonable to expect that it will be found breeding more commonly than we suppose. Three or four were seen

by Prof. W. S. Blatchley near Harrodsburg, May 8, 1896, an unusually late date for southern Indiana. The opening of the shooting season, September 1, 1889, several Shovellers were killed at Water Valley. They came to the decoys, and their weight attracted so much attention that several were weighed and found as heavy as two pounds each. Those who have handled spoonbills in the spring will appreciate the weight given, as they are then usually merely a bunch of feathers. They return from the north through September and, more numerous, in October. In the latter month most of them pass on southward. Rarely may one remain till the middle of November.

17. GENUS *DAFILA* STEPHENS.

α^1 . Speculum violet, with black, white, and buffy.

D. acuta Linn. 36

36. (143.) *Dafila acuta* LINN.

Pintail.

SYNONYM, SPRIGTAIL.

Adult Male.—Tail cuneate, when fully developed the central feathers projecting and nearly equaling the wing; bill, black and blue; feet, grayish-blue; head and upper neck, dark brown, with green and purple gloss; sides of neck, with a long white stripe; lower neck and under parts, white; dorsal line of neck, black, passing into the gray of the back, which like the sides, is vermiculated with black; speculum, greenish-purple anteriorly bordered by buff tips of the greater coverts, elsewhere by black and white; tertials and scapulars, black and silvery. *Adult Female*.—Tail much shorter and not so narrow; the whole head and neck speckled or finely streaked with dark brown and grayish or yellowish-brown; below, dusky freckled; above, blackish; all the feathers pale-edged; only a trace of the speculum between the white or whitish tips of the greater coverts and secondaries.

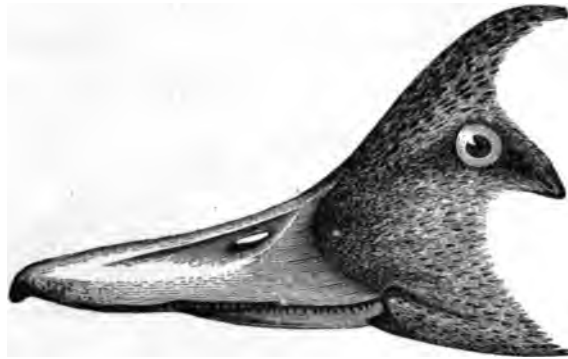
Length, about 26.00-30.00; wing, 10.25-11.20; middle tail feathers, 7.25-9.50; bill, 1.85-2.15; tarsus, 1.55-1.85. Female smaller.

RANGE.—Northern Hemisphere. In North America it breeds from north Illinois and Wisconsin northward to Arctic regions, but mostly far north. Winters from southern Illinois south to Cuba and Panama.

Nest, on the ground or in tuft of grass. *Eggs*, 6-12; buff or grayish-green; 2.21 by 1.47.

Abundant migrant in spring; not common migrant in fall. Perhaps occasionally winters. The winter of 1884-5 a few ducks of this species spent most of that season at Shawneetown, Ill. This is but a

short distance below the mouth of the Wabash River. The only report of their wintering farther north than Shawneetown was from Mr. W. B. Hull, Milwaukee, Wis. Mr. Hull says: "For about a week the whole bay was frozen over with ice from two to fourteen inches thick. During this time the pot-hunter butchered numbers of Pintail Ducks. The ducks were half starved, and would allow a man to approach within 20 feet of them. Icemen were cutting ice close to the shore, and ducks came right among them to get to the open water. A friend who was on the ship Oneida during her 25 days in the ice, said that the ducks (Pintails mostly, but a few "northern" ducks he did not recognize) were "frozen in." When walking on the ice near the boat, he



Head of Female Pintail.

saw hundreds of ducks in a solid casing of ice. In the winter of 1873-74 they were killed in the same way. (Cooke, Bird Migration in Mississippi Valley, pp. 68, 69.)

These are, with the Mallards and Ring-necks, the earliest river ducks to move northward. They begin to migrate the first open weather. This may occur any time from the middle of February to the middle of March. The following dates will give the records of the first reports for the State for the years mentioned:

- 1885. Mar. 13.—Brookville.
- 1886. Feb. 26.—Bloomington (Evermann).
- 1889. { Feb. 15.—Frankfort (Ghere).
- { Feb. 20.—Vincennes (Balmer). Ducks by thousands first bird wave.
- 1891. Feb. 14.—English Lake (Deane).
- 1892. { Feb. 6.—Liverpool (Parker).
- { Feb. 27.—English Lake (Deane).
- 1894. Mar. 11.—English Lake (Deane).
- 1895. Mar. 15.—Liverpool (Parker).
- 1896. { Feb. 6. Liverpool (Parker).
- { Mar. 4.—Brookville.

In the spring they are very numerous in March for a few days, or possibly for two or three weeks, depending upon the weather. Then they pass north. When they are present in any numbers in the spring they are found by thousands. I have a few records of March 20-25, when they were abundant. The latest records when they were found in numbers is from English Lake, March 26, 1892. Seldom are individuals noted after that. May 4, 1890, Mr. Ruthven Deane noted several Pintails, mostly in pairs, at English Lake. May 10, 1891, he caught a crippled male, whose broken wing had healed, at the same place. In 1889 they remained until the first week in May. These are unusually late dates for this species.

They begin to return in September. In 1889 Mr. Deane reported quite a number at English Lake, September 21. Their numbers in fall are but a small fraction of those which go north in the spring. Mr. J. G. Parker, Jr., gives as the result of his observations for a number of years, that there is not one Pintail in the fall where there are ten in the spring. They remain, however, until the ice covers the water and drives them further south. November 22, 1891, Mr. Deane reported most ducks had left English Lake, but a few Pintails still remained. The year 1891 was one of several very dry years. In the fall the marshes were dry and the bulk of English Lake an exposed mud bank. The ducks, among which the Pin-tails were conspicuous, seemed greatly to enjoy taking a mud bath in the oozy mud.

They have been reported nesting in Illinois and Wisconsin and northward through Manitoba and the Northwest Territory. According to Mr. Robert Kennicott, the breeding range of the Pintail extends into the Arctic regions, farther than any of the fresh-water ducks, comparatively few breeding south of Great Slave Lake. Both Mr. E. W. Nelson and Mr. L. M. Turner, report it very abundant along the Yukon and the Alaskan coast. It is one of the first water fowl to begin nesting. The nest is made upon the dry ground or in a tuft of grass. Mr. Nelson notes that in summer the Pintail has a low, mellow whistle, which is used to call its mate, in addition to a loud "quack," much like, but less sonorous, than that of the Mallard. (Nat. Hist. Coll. in Alaska, p. 70.)

18. GENUS AIX BOIR.

*a*¹. Speculum green.**A. sponsa** (Linn.). 37***37. (144). Aix sponsa (LINN.).****Wood Duck.**

Synonyms, TREE DUCK, SUMMER DUCK.

Adult Male.—Head crested, metallic green and purple; line above and behind the eye, white; above, coppery black, with a gloss of green and purple; beneath, white; upper part of the breast, chestnut; sides, buffy, very finely variegated with black; the shoulder bordered also

**Wood Duck.**

with black; covert and quills, with more or fewer tips and shades of white and purple. **Adult Female.**—Chestnut of the neck detached and dull; sides, not striped; head and neck, dull; bill, reddish; edges dusky; legs and feet, yellowish inside.

Length, about 19.00-20.50; wing, 9.00-9.50; bill, 1.40.

RANGE.—Temperate North America, breeding throughout its range. Cuba. Accidental in Europe. Winters from southern Indiana and Illinois southward.

Nest, of grass and leaves in a hole in tree. **Eggs,** 8-14; pale buff; 2.00 by 1.50.

Migrant and summer resident in some numbers. Some winters it may be found in southern part of the State. Breeds in suitable localities throughout the State. It is known also as Tree Duck and Summer Duck. They begin their northward journey with the

first bird wave in the spring. In 1888 Prof. B. W. Evermann reported a female, from Terre Haute, February 29. In 1890 Mr. S. A. Warner noted two, the first of the season, at St. Clair Flats, Mich., March 11, and in 1897 Mr. Jerome Trombley noted two at Petersburg, Mich., March 3. It is not often, however, that the movement is so early.

Usually they are observed going north after March 15 in this State, and correspondingly later, northward.

Mr. John S. Elliott informs me it is a permanent resident in Posey County, in the extreme southern part of the State.

Often they are paired when migrating, and through April most of them are mated, and begin looking for nesting sites. The nests are generally placed in a cavity or hollow tree near water. The earliest young are ready to leave the nest the latter part of May. May 25 is the earliest I have ever known them to be out.

Under date of July 29, 1889, Mr. Ruthven Deane writes the following concerning the Wood Duck at English Lake: "I saw perhaps seventy-five Wood Ducks during the day—some single ones, many pairs and some flocks of ten to fifteen. During the hot days they like to stay in shady nooks, under brush piles on the edge of the river. Yet many content themselves by basking in the sun, sitting on some dead log on the river, and in most cases, just at a bend, where they can keep an eye open for intruders who may be coming up or down. The young are now well grown, and while many do not get off the water with the agility of adults, yet they are strong on the wing when they get a little headway." Mr. Deane informs me they were unusually numerous for the time of year at English Lake August 8, 1897.

I am informed that they are reported to have been found breeding in trees, on the scrub oak ridges, as much as a mile and a half or two miles back from the Kankakee River and away from all bodies of water. The young, soon after being hatched, are said to be carried to the river by the parent birds. Audubon and Wilson both speak of the parents carrying the young to water, but I do not know that anyone heretofore has reported an instance of their breeding at such a distance from water, requiring such a journey to convey the young to it.

As the broods hatch they are led to the more retired waters and taught all that is necessary to know about feeding, diving and flying, together with all the necessary finer accomplishments. When they are deemed ready to care for themselves, they all come out upon the more open stream. In some favored localities, quite a number could formerly be seen by September 1. They afford the principal early duck shooting. They have been noted in recent years

as summer residents and breeding in the following counties: Posey, Knox, Gibson, Vigo, Monroe, Carroll, Wabash, Tippecanoe, Starke, Newton, Lake, Laporte, Dekalb, Steuben, and Lagrange. In none of them are they found in such numbers as they were fifteen or twenty years ago, and in some of them in which they were the most common duck, they are not now seen in summer. I do not know that a Wood Duck has bred in Franklin County in fifteen years. Before that time there were places where they were known to rear their young each season. Mr. C. E. Aiken says it was formerly one of the most abundant summer residents, but now only seen occasionally. During several trips to Water Valley (on the Kankakee River), in 1886, '87 and '88, in April and May, he saw only two or three pairs. Mr. J. G. Parker, Jr., says they breed in the woods bordering our rivers and lakes. Until late years the Kankakee River region afforded excellent Wood Duck shooting. The Burr Oak bottoms along that river have been favorite nesting places. In 1888 B. W. Evermann, writing of the ducks of Carroll County, says: "Formerly a common summer resident, but now one of the rarest ducks of this region." (*The Auk*, October, 1888, p. 346.)

The common note of the drake is *peet-peet*, but the *alarm* note is not unlike the first attempts of a young cock to crow. It may be expressed by the syllables "*oe-eeh*."

19. GENUS *CAIRINA* FLEMING.

38. (—) *Cairina moschata* (LINN.).

Muscovy Duck.

Adult Male.—Head, neck and lower parts uniform glossy brownish-black; upper parts brilliant metallic blackish-green, glossed with purple anteriorly and on rump; wing coverts and above and below entirely pure white; caruncles along sides of forehead, etc., bright pinkish-red or rose red in life; bill varied with blackish and pinkish white or light rose-color. *Adult Female*.—Entirely brownish-black, except some of the upper greater wing coverts, which are white; upper parts glossed with metallic green and purple.

Length of male, nearly 36.00; wing, about 16.00; tail, 9.00; tarsus, 2.00 or more. Female smaller.

RANGE.—Tropical America, from Paraguay and southern Brazil to Mexico and Louisiana.

A specimen of this beautiful duck was shot near the mouth of Big Miami River, in Indiana, in January, 1890, and is now in the possession of Mr. J. M. Bauer, of Lawrenceburg, Ind. Mr. Robert Ridgway

Common migrant in suitable localities. It may occasionally remain through the summer and breed. A male was taken June 28, 1879, near Sandusky, O. (Langdon, Summer Birds of N. O., Marsh, p. 228.) Mr. W. H. Collins found it breeding at St. Clair Flats, Mich. (Bull. Nutt. Orn. Club, 1880, pp. 61, 62.)

The Red-head spends the winter south of us, being very common along the gulf coast. They vary in the time of their northward migration with the weather. Usually it does not appear in Indiana until some time in March, but Mr. Stephen A. Warnie reported six seen at St. Clair Flats, Mich., February 13, 1890. No more were observed until March 8. Mr. Warnie reports a few breeding then. In 1886 the first was killed at English Lake, Ind., March 17; 1887 the first was killed, March 4. A few were seen March 6, 1892. (Deane.) In 1888 Prof. B. W. Evermann reported the first noted in the State at Terre Haute, March 9.

Some years many of them pass north early in April; other years they remain well through the month. At English Lake, May 3, 1891, a number were seen. But on the 10th a single one was noted with Scaup Ducks. (Deane.)

The Redhead breeds from the northern United States northward through Manitoba, Assiniboia, Alberta, and the Northwest Territory, but apparently does not reach the Arctic Ocean.

The following account of a nest obtained by Mr. Collins, above referred to, is of interest: "The past season I had the good fortune to find two nests of the Redhead Duck (*Aythya americana*), containing respectively, seven and eight eggs. The first was placed on some drifted rushes on a sunken log, and was composed of flags and rushes, evidently taken from the pile of drift upon the log, as they were short pieces, so short, in fact, that the nest, when lifted with the hands, fell in pieces. The nest was about four inches deep and lined with down from the female. This nest contained seven fresh eggs of a creamy color, and varied in measurements from 2.30 by 1.75 to 2.22 by 1.66 inches, and were of a uniform oval shape, very little smaller at one end. The other nest was built similar to a Coot's nest: that is, of flags and grass interwoven at the base of a bunch of flags growing in water three or four feet deep. It was built in such a way that the nest would rise and fall with the water. This nest also contained down and eight fresh eggs, uniform in size, shape and color with the others. The birds, male and female, were flying around, and often came close to me. The cry of the female resembles the cry of the Mallard so nearly that had I heard and not seen it I should have supposed it to have been the Mallard."

The greater number of persons, perhaps, cannot distinguish between the Redhead and the much-esteemed Canvas-back. While their habits are quite similar in certain respects, they like the same food, have substantially the same range and in some ways resemble each other, it requires but little instruction to teach one to discriminate. The long, flat bill with slightly hooked nail of the Canvas-back will distinguish it in any plumage from the shorter, less flattened bill, with decidedly hooked nail of the Redhead.

Both of these ducks are found in wild celery, and being great divers, are enabled to secure its roots for themselves. When feeding upon this favorite food, the famed Canvas-back is said to be no better than the Redhead. In fact, some persons who claim to have a right, by reason of their experience in gastronomy, to speak with authority, say the latter is the superior bird. It is further said, in some hotels, where the price of the two ducks is quite far apart, they are both served from the same vessel, which, had one noted carefully what went into it, would have been found to be filled with Redheads.

In fall these ducks return in September, usually toward the latter part. Often they leave very soon. At other times they remain past the middle of October, and occasionally a few may remain later. In 1881 the last Redhead was killed at English Lake, September 21. In 1889 these ducks were seen in small flocks September 25, and in 1895 they were noted at Liverpool, Ind., October 18.

40. (147) *Aythya vallisneria* (WILS.)

Canvas-back.

Adult Male.—Head and neck reddish-brown, the former blackish on top; chest, upper back, lower rump and upper and under tail coverts black; rest of plumage (except quills, etc.) white, the upper parts, sides and flanks and ventral region finely waved or vermiculated with dusky. *Adult Female*.—Head, neck, chest, and upper back raw-umber brown; the fore part of the head and foreneck whitish; scapulars, sides and flanks similar, but tips of the feathers vermiculated with whitish.

Length, about 20.00-23.50; wing, 8.75-9.25; bill, 2.10-2.50; greatest depth of bill, .75-.80.

RANGE.—North America, breeding in interior from Minnesota north to Alaska. Winters from Southern States southward to Guatemala.

Nest, on ground, of grass and weeds, lined with feathers. *Eggs*, 6-10; grayish-drab or greenish-buff; 2.48 by 1.76.

Regular migrant; some years not common, even in the lake district. Throughout the greater part of the State quite rare.

It winters south of us. Owing to the fact that our lakes do not afford "wild celery," or "water celery," as it is sometimes called (*Vallisneria spiralis*), we do not furnish a very attractive field for the Canvas-back. Although it is much scarcer in the interior than along the Atlantic Coast, it is found in some numbers where its favorite food grows. It is quite abundant at Fox Lake, fifty miles north of Chicago, and at Lake Koshkonong, in Southern Wisconsin, at both of which places *Vallisneria* grows.

This is the famed Canvas-back, the game bird, which, with the equally well-known Diamond-back, the much-sought terrapin of the tide-water marshes, has made the Chesapeake region famous. There is much in a name. To some people apparel looks well if it costs much; likewise, the cost of a meal determines its flavor. The Canvas-back is good, splendid eating, but there are half a dozen other ducks which sell for much less money that are equally as good.

The Canvas-back has been known to winter in southern Illinois. (Cooke, Bird Mig. Miss. Valley, p. 70.) Its movements correspond with those of the last mentioned species, which is much more common than this.

In 1896 a large flock was observed by Mr. J. G. Parker, Jr., at Liverpool, February 28. This is the earliest record for the State. In 1886 the first was shot at English Lake March 21. At that place it is not abundant, and but very few are killed each year. (Deane.) It departs for the north early in April. Mrs. Hine reports it from Sedan, Dekalb County, April 12, 1894. In the fall I observe but few notes of its occurrence. It remains into November, however, as Mrs. Hine reports it from Dekalb County November 5, 1894. It was observed in Franklin County by Dr. R. Haymond, and some years ago I saw a fine male, killed by Mr. S. S. Harrell near Brookville.

The Canvas-back breeds in the interior very far to the northward, a few breed in Minnesota and Manitoba, and it has been reported breeding commonly, but at one place—Ft. Yukon—by Mr. Dall.

Subgenus *FULIGULA* Stephens.**41. (148). *Aythya marila nearctica* (STEJN.).****American Scaup Duck.**

Synonyms, BIG BLACK-HEAD, BLUE-BILL, BROAD-BILL, RAFT-DUCK.

Adult Male.—Head, neck and chest uniform black, the first with greenish gloss; back and scapulars grayish-white, zigzagged with black and yellow; speculum white, tipped with black; bill dull blue with black nail; legs plumbeous. *Female*.—Space about base of bill, white; rest of head and anterior parts brown; and other black parts of the male rather brownish; speculum and belly white.

Length, 18.00-20.00; wing, 8.25-9.00 (8.63); bill, 1.85-2.20 (2.03); greatest width of bill, .85-1.05 (.97); least width, .70-.90 (.79).

RANGE.—North America. Breeds in Minnesota and Manitoba and northward through Alaska. Winters from southern Illinois and Long Island to Central America and West Indies.

Nest, on ground in grassy or marshy places about open lakes. *Eggs*, 6-10; buffy, olive-gray; 2.54 by 1.71.

Rare migrant; most often noted in the Wabash Valley. Quite rare in fall.

Some years they begin the spring migration by March 1 and occasionally remain until April 10. It has been noted in Knox County by Angus Gaines. Vigo County, about March 1, 1886, (Prof. O. P. Jenkins.) March 26, 1887, several seen; a male killed. (Prof. B. W. Evermann.) Also, by Dr. J. T. Scovell. Monroe County, March 4, 1886, one (B. W. Evermann). Dekalb County, by Mr. H. W. McBride, and by Mr. J. T. Feagler April 5 and 10, 1896. Allen County, by Mr. C. A. Stockbridge. Lake County, by Mr. J. G. Parker, Jr., and April 9, 1887, by Mr. Graham Davis. In Franklin County Dr. Rufus Haymond noted it, and I recorded it March 4, 1896. I have no fall record. It is not noted in the interior as commonly in fall as in spring.

While Mr. W. H. Collins has observed it breeding at St. Clair Flats, Mich. (B. N. O. C. V., p. 61), and its nesting has been noted in Minnesota, it usually breeds from Manitoba northward to the Alaskan Coast and Greenland. In one's mind birds, especially ducks, are recalled by association. I think of this species being noticeably so much rarer than its miniature and relative, the Lesser Scaup Duck, and recall that the Canvas-back is likewise rarer than that for which it is sometimes taken, the Redhead, and the Black Duck is proportionately rarer than its near relative, the Mallard.

42. (149). *Aythya affinis* (EYT.).*Lesser Scaup Duck.**

Synonyms, LITTLE BLACK-HEAD, LITTLE BLUE-BILL.

Similar to last species (*A. marila nearctica*), but smaller and flanks waved or zigzagged with blackish.

Adult Male.—With head glossed with purplish instead of green.

Length, 15.00-16.50; wing, 7.50-8.25 (7.81); bill, 1.58-1.90 (1.75); greatest width of bill, .80-.95 (.89); least width, .60-.78 (.69).

RANGE.—North America, breeding chiefly north of United States, rarely south of central Michigan, Iowa and Indiana. Winters from Virginia and Gulf coast south to Guatemala and West Indies.

Nest, on ground in swampy places, similar to last. *Eggs*, 6-10; color same as last; 2.25 by 1.58.

Very abundant migrant and rare summer resident.

This is the most common of all our ducks. In April, October and November the open lakes of northern Indiana are literally covered with them. On Wolf Lake, Indiana, and Calumet Lake, Illinois, and other small lakes of that vicinity at those seasons of the year, and sometimes as early as March 20 (1886), in spring, they congregate by thousands. They form the principal duck shooting in the vicinity of Chicago.

These ducks form a part of the second early migrants. They are not so early as the Mallards and some other kinds, but follow promptly after them. Some years they are noted the first week in March and others the middle of that month. They remain through April, some years into May, occasionally are seen in June. The following dates will give some idea of its occurrence: At English Lake, first one killed, 1886, March 14; 1887, March 9; 1889, March 14; 1892, March 6, first noted. (Deane.)

In 1886, March 20, there were thousands at Wolf Lake. In 1896, March 20, three were observed at Kouts. (Parker.)

I have observed them at Brookville May 6 (1883). and Professors Evermann and Blatchley noted it at Gosport. May 8, 1886.

Mr. Ruthven Deane informs me upon good authority that a pair of Lesser Scaup Ducks, followed by a brood of young, were seen at English Lake in June, 1886. One or both of them were supposed to be "cripples." Mr. W. H. Collins found a nest of this species at St. Clair Flats, Mich. (B. N. O. C.; V., p. 61.)

They seem to pair late. Early in May they begin to be observed in pairs, and by the middle of the month most of those that are found

with us are paired. Some, however, remain in flocks, and it is noticeable that those are principally males and become very tame, permitting one to approach at times within sixty yards. The following dates from Mr. Deane will show how late they are found at English Lake:

1888. May 6.—Flocks of 200; May 20, a flock of 20; June 5, flock of 13.
 1890. May 4.—Saw many; May 11, many still remain.
 1891. May 10.—Abundant; flock of 200 on the Lake, on river mostly paired;
 May 31, flock of 25.
 1892. June 6.—Saw one "cripple."

This duck returns from its summer home late in September or early in October. Mr. Deane notes the first at English Lake September 22, 1889, and in 1886 the last of the season was shot October 20. Usually between these dates, it would appear, the bulk are noted. Often, however, its stay is lengthened into November; in fact, some years its disappearance depends upon the closing of the streams by ice. In 1890 Ulrey and Wallace noted a specimen taken at Long Lake November 15, and in 1891 Mr. Deane reported the Kankakee River at English Lake all open, December 21, and four Lesser Scaup Ducks shot, and added, several flocks of these Scaup Ducks were observed December 19. From this it will not be unexpected to have them winter in this State mild winters. This was formerly the most abundant duck on our western rivers, and wintered along the lower Mississippi. There it occurred in such flocks that Audubon said it was known as the "Flocking Fowl."

43. (150). *Aythya collaris* (Donov.).

Ring-necked Duck.

SYNONYM, RING-BILL.

Adult Male.—Head, neck, chest, undertail coverts and upper parts black, the head with a violet-purple gloss and middle of neck with a more or less distinct collar of chestnut; chin with a triangular white spot; bill transversely banded with black; grayish-white and plumbeous. *Adult Female*.—Top of head and back of neck, dark brown; rest of head and neck paler, becoming nearly or quite white anteriorly and on throat; chest, sides and flanks deep fulvous brown; the speculum bluish-gray, as in the male. Female much resembles female Redhead, but is smaller.

Length, 15.50-18.00; bill, 1.75-2.00; tarsus, 1.30-1.45; wing, 7.50.

RANGE.—North America, breeding from Iowa, southern Wisconsin and Maine northward. Winters from southern Illinois southward to Guatemala and West Indies.

Nest, on ground among reeds and grass about marshy lakes and ponds. *Eggs*, 6-12; color similar to foregoing species; 2.27 by 1.63.

Tolerably common migrant; in the northern part of the State it is common in the spring and fall. Mr. Robert Ridgway notes that it often passes the winter in the southern portion of Illinois. (Birds of Illinois, Vol. II, p. 165.) The habits of these ducks are substantially those of the last species. This and both the Scaup Ducks are known as "Black-heads."

March 8, 1879, a Ring-bill was killed by Mr. W. M. McCleery at Brookville. In 1888 I noted it March 10, and the same year Mr. E. R. Quick reported a male and female March 31.

The earliest spring record of this species also comes from English Lake, where it was taken February 27, 1892. In 1892 it was abundant March 6. That year a cold wave came on in March, and on the 13th the lakes were frozen over, and Ring-necks, Mallards and Pintails sat in droves on the ice. (Deane.)

At the same station the first was shot March 14, 1886, and March 6, 1887. In 1889 it was first noted there March 14, and was abundant March 17.

Thus it would appear they may be expected when the waters are open, which may be late in February some years and the middle of March others.

They leave the latter part of April. The latest I know them to have remained was May 11 (1890). This duck has been noted breeding in the vicinity of Minneapolis, Minn., and its breeding range is from that locality and Iowa northward, in the interior. It is rare in Alaska. In the fall they sometimes reappear early in September. Other years they are not common the latter part of that month. They remain into November, sometimes quite late. Mr. Deane informs me that a few were still at English Lake November 22, 1891, and Mr. Charles L. Cass says they remained at Hillsdale, Mich., until November 26, 1894.

20. GENUS GLAUCIONETTA STEJNEGER.

- α^1 . Wing with uninterrupted white patch; head puffy, it and throat glossy green in male; head and upper neck grayish brown, head scarcely puffy in female.

G. clangula americana (Bonap.). 44

- α^2 . Wing with white patch crossed with blackish band; head somewhat crested; it and neck steel blue in male; in female, head not crested, it and upper neck snuff brown.

G. islandica (Gmel.). 45

44. (151). *Glaucionetta clangula americana* (Bonap.).

American Golden-eye.

Synonyms, WHISTLER, WHISTLE-WING.

Adult Male.—With the head and upper neck glossy green and a white oval or rounded loreal spot, not touching the base of the bill throughout; lower neck all round, lower parts, including sides, most of the scapulars, wing coverts and secondaries, white; the white of outer surface of wings continuous; lining of wings and axillars dark; most of upper parts black; no waving on the back or sides; bill black, with pale or yellow end, nostrils in anterior half; feet orange; webs dusky; eyes yellow; head uniformly puffy. *Female*.—With head snuff brown, no white patch in front of eye and white of wings not always continuous.

Length, about 18.00; wing, 8.00-9.00 (8.52); bill from tip to extremity of frontal angle, 1.65-1.80 (1.73); depth of bill at base, .95-1.05 (.99); width, .70-.75 (.74); width of nail, .18-.20; tarsus, 1.30-1.55 (1.43). Female smaller.

RANGE.—North America, breeding from Maine and British Provinces northward. In winter from Great Lakes southward to Cuba and Mexico.

Nest, in hollow tree, of grass, leaves, moss, etc., lined with down. *Eggs*, 6-10; ashy-green; 2.40 by 1.75.

Common migrant and winter resident. On southern Lake Michigan this is the common winter duck, staying all winter. On Lake Erie it is also found at that season. They may be observed throughout the State in winter wherever there is open water.

They begin to go north with the first thaws, and those from the South continue passing until near the middle of April, in which month they are sometimes very common. The latest date for the State is April 17 (1885), when I found it at Brookville. Severe winters they are fewer in numbers and less generally distributed. Over much of the more level part of the State, when the quiet waters are frozen, they are not found. Mr. Deane informs me they remained on the Kankakee River all winter, 1890.

In 1892, February 27, they were more abundant than any other species, generally in flocks of 15 or 20. The first was shot in 1886, March 14, and the first noted about March 8, 1894. It breeds from the northern limits of the United States northward to Hudson Bay and Alaska, and Mr. Nelson reports, upon Mr. Dall's authority, that it is a winter resident in the Aleutian Islands. They arrive in the fall, generally in November.

They are usually quite shy and difficult to approach. Often the hunter will try to approach a bunch of ducks, and suddenly, a few Golden-eyes will arise from the flock, their whistling wings giving the alarm to the rest of the company and telling the enemy of the game that has flown. The whistling note made by their wings is characteristic, and has given them the name "Whistler" and "Whistle-wing." They are expert divers, and often, even after they are wounded, escape by diving.

45. (152). *Glaucionetta islandica* (GMEL.).

Barrow's Golden-eye.

Adult Male.—Very similar to the preceding, differing chiefly in being larger in size; gloss of the head, purple and violet; loreal spot larger; white on the wing, divided by a dark bar; feathers on the hind-head lengthened into a crest; bill blotched with red. *Female*.—Can probably not be distinguished from that of the preceding.

Length, 21.00-23.00; wing, 9.00-9.40 (9.17); bill from tip to frontal angle, 1.65-1.80 (1.75); depth at base, .95-1.10 (1.03); width, .75-.85 (.81); width of nail, .35; tarsus, 1.50-1.60 (1.57). Female smaller.

RANGE.—North America; breeds from Gulf of St. Lawrence to Greenland and Alaska, and south in Rocky Mountains. Colorado. South in Winter to southern Indiana, Illinois, and that latitude.

Nest and Eggs, similar to the last species.

Rare visitor from the north in winter and spring. It has twice, at least, been taken in this State. Dr. F. Stein took it on the lower Wabash River in Gibson County in 1874. (Bull. Nuttall. Orn. Club, July, 1876, p. 41.) Prof. B. W. Evermann shot a female on Deer Creek, near Camden, Carroll County, March 19, 1885. (The Auk, October, 1888, p. 347.) Dr. Brayton says it is a "winter resident on Lake Michigan." Mr. F. M. Woodruff informs me that he shot two specimens off Lincoln Park, Chicago, on Lake Michigan, December 11, 1896, and Mr. J. G. Parker, Jr., has a specimen taken at Fox Lake, Illinois, January 2, 1889. We are about at the southeastern limit of its range.

Mr. Robert Ridgway calls attention to the fact that while the males of this species and the last may readily be distinguished, according to the characters specified, it is difficult to give constant characters by which the females of these two species can be infallibly determined. He says: "The examples, which are known to represent *G. islandica* differ from the positively determined females of *G. clangula americana* in the following respects: (1) The color of the head and upper half of the neck is considerably darker, being a rich sepia or snuff-brown, rather than a grayish brown; (2) the greater wing coverts are distinctly tipped with black, forming a conspicuous dusky stripe between the two larger white areas of the wing, which in *G. clangula americana* are (usually at least) merged into one continuous space.

"Further than this we find no distinction, while indeed some examples are decidedly intermediate in both respects, as to render it quite uncertain to which species they belong of the two characters named. However, the color of the head seems for the most constant, and may, perhaps, be found quite distinctive." (Birds of Illinois, Vol. II, pp. 169, 170.)

21. GENUS CHARITONETTA STELLERER.

a¹. Nostril nearer base than tip of bill; more or less white behind the eye, none in front; head of male very puffy. *C. albeola* (Linn.). 46

46. (153). *Charitonetta albeola* (LINN.).

Buffle-head.

Synonyms, BUTTER DUCK, BUTTER BALL, SPIRIT DUCK.

Adult Male.—Head and upper neck glossy green, bronze and purple; a band of white extending from eye to eye across the back of head; lower neck, lower parts, speculum, wing, coverts, and outer scapulars pure white; rest of upper parts black. *Adult Female*.—Head, neck and upper parts generally, dusky grayish-brown; a spot behind each eye, speculum and lower parts, white.

Length, 14.25-15.25; wing, 6.75-6.90; bill, 1.10-1.15; female, smaller.

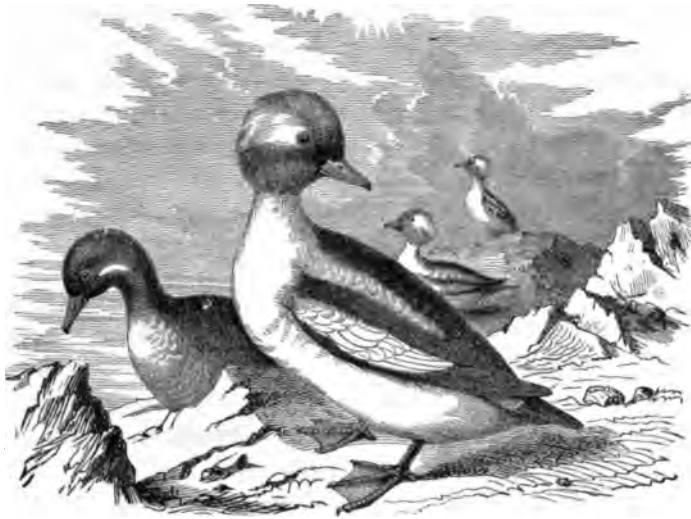
RANGE.—North America, breeding in Iowa and Maine and that latitude, through the fur countries, and northward to Alaska. Winters from Michigan to Cuba and Mexico.

Nest, in hollow tree. *Eggs*, 6-14; dull light buff; 1.98 by 1.46.

Common migrant and winter resident. Some winters they are present throughout the entire State; others when the northern streams and lakes are ice bound they are only found along the southern border.

Throughout the southern part of the State this little duck is better known than the Golden-eye. Although it is found in some numbers on Lake Michigan, it prefers the smaller lakes and streams, often associating with the Lesser Scaup Duck in bunches of three or four. It arrives and departs with the latter duck.

In 1888 Prof. Evermann took a female at Terre Haute, February 29. In 1889, Mr. J. A. Balmer reported small numbers at Vincennes, February 21, while they were not observed at English Lake until March



Buffle-Head.

17. In 1892, Mr. Deane reported a few pairs seen at English Lake, February 27. In 1886 the first was killed at English Lake, March 19, and in 1892 they were first observed there, March 6.

Usually the migration is principally in March, the birds remaining, in the north of the State, from the first to the middle of April. Mr. J. G. Parker, Jr., reports several at Kouts, Ind., April 15, 1892, and Mr. Deane saw a few at English Lake May 4, 1890. That same year they remained at St. Clair Flats, Mich., until May 9. (Warnie.)

They have been observed at St. Clair Flats, however, in summer, and it is said to breed there (McIlwraith, *Birds of Ontario*, p. 84). Dr. F. W. Langdon reports it also in summer from near Sandusky, O. (*Summer Birds of N. Ohio*, Marsh, J. C. S. N. H., Vol. III, 1880, p. 229).

It breeds from Iowa northward throughout Manitoba to the Alaskan coast.

This duck is well known to sportsmen as a diver. Often it escapes by diving rather than by flying.

22. GENUS CLANGULA LEACH.

a¹. Feathers at base of bill reaching farthest forward on the forehead.

C. hyemalis (Linn.). 47

47. (154). *Clangula hyemalis* (LINN.).

Old Squaw.

Synonyms, OLD WIFE, SOUTH SOUTHERLY, LONG-TAILED DUCK.

Adult Male in Winter.—Sides of head light smoke gray; the eyelids and rest of head and neck, upper part of chest and upper back, white; a dusky patch on each side of neck; breast and most of upper parts black; the scapulars pale pearl-gray or grayish-white; lower parts white, the sides tinged with pearl-gray. *Adult Male in Summer*.—Fore part of head pale grayish; eyelids and space behind eye white; rest of head and neck, with upper parts generally, sooty blackish, or dark sooty brown; the upper back varied with fulvous and scapulars edged with same; breast and upper belly dark sooty-grayish; remaining lower parts white, shaded on sides with pale pearl-gray. *Adult Female in Winter*.—Head, neck, and lower parts chiefly white; top of head dusky; chest grayish; upper parts dusky brown, the scapulars bordered with light brownish, sometimes tipped with grayish. *Adult Female in Summer*.—Head and neck, dark grayish-brown, with a whitish space surrounding the eye, and another on each side of neck; otherwise much as in the winter plumage, but scapulars chiefly light brown or fulvous, with dusky centers.

Length (of male), 20.75-23.00; wing, 8.50-9.00; middle tail feathers, 8.00-8.50; bill, 1.10; the female smaller (about 15.00-16.00 long), with middle tail feathers not conspicuously lengthened.

RANGE.—Northern Hemisphere. In North America, south to the Potomac and the Ohio (more rarely to Florida and Texas) and California; breeds far northward.

Nest, on margins of lakes or ponds, among grass or bushes. *Eggs*, 6-12; drab, shaded with green; 2.05 by 1.49.

Very common winter resident on Lake Michigan. Away from that lake it is an exceedingly rare winter visitor, although it has been reported from a number of localities throughout the State.

Dr. F. Stein observed it on the lower Wabash River (Bull. Nuttall Orn. Club, July, 1876, p. 44). A specimen was taken by Mr. T. J. Baum near the mouth of the Great Miami River (Dearborn County, Indiana) February 24, 1880. (Journal Cin. Soc. Nat. Hist. December, 1881, p. 341).

Mr. Charles Dury informs me there is a male in the collection of the Cuvier Club, Cincinnati, O., that was taken on the Whitewater River in March. There is a male in my collection taken by Mr. R. Williams at Metamora, Franklin County, Indiana, about 1882. Mr. J. E. Beasley reports having mounted a specimen killed near Thorntown in 1889. Mr. C. A. Stockbridge reports one specimen from Allen County, and Dr. Vernon Gould reported it from Rochester, March 7, 1892.

They come from the north very late. The earliest date given for their arrival is that given by Mr. J. W. Byrkit, who reported it very abundant on Lake Michigan, off Michigan City, December 12, 1887.

They are great divers. The depth to which they dive may be known by the fact that they are often caught in that vicinity in abundance in gill nets in twenty to thirty fathoms of water.

Mr. J. G. Parker, Jr., and Mr. F. M. Woodruff both report it very abundant on Lake Michigan the winter of 1894-5, and quite common the winter of 1896-7. The first mentioned winter, Mr. Parker tells me, during January and February, many of these ducks were shot off the government pier at the entrance to Chicago harbor. January 14, 1897, both the gentlemen mentioned reported it from Millers, Ind. February 1 following Mr. Parker reported it very abundant at that same place. He saw several enormous flocks.

They usually pass north in February. The latest record I have is one given by Mr. Stewart E. White, Grand Rapids, Mich., where he observed three April 2, 1891. This duck is a great gabbler. To this fact it owes several of its names, among them "Old Wife," "Old Squaw," and "Scolder." Its notes are different from those of any other duck. Undoubtedly the name by which it is called some places, south-southerly, comes from the interpretation of these notes into south-south-southerly. Its call consists of five notes, which may be interpreted into several fanciful sayings.

Mr. Nelson speaks of its harmonious notes during the breeding season, when it is very abundant in Alaska, and says the fur traders of Upper Yukon have given it the well merited name Organ Duck. Breeds far north. It is one of the most abundant summer residents on the Alaskan coast.

21. GENUS *OIDEMIA* FLEMING.

a¹. Wing with large white patch; frontal feathers not reaching farther forward than those on sides of culmen. Subgenus *MELANITTA* Boie.

O. deglandi Bonap. 48

a². Wing with no white patch; frontal feathers reaching nearly or quite to nostrils, none on sides of culmen. Subgenus *PELIONETTA* Kaup.

O. perspicillata (Linn.). 49

Subgenus *MELANITTA* Boie.

48. (165). *Oidemia deglandi* BONAP.

Velvet Scoter.

Synonym, WHITE-WINGED SCOTER.

Adult Male.—Black; speculum and patch under eye, white; feet, orange red, with dusky webs; bill, black, broadly tipped with orange. *Female*.—Sooty brown, grayish below; whitish about head; speculum, white.

Length, about 21.00; wing, 10.65-11.40; bill, 1.40-1.70; depth of upper mandible at base, 1.10-1.30; tarsus, 1.80-2.10.

RANGE.—Northern North America. Breeds from Labrador and Manitoba to Alaska and Arctic coasts; south in winter to Chesapeake Bay, southern Indiana and southern Illinois.

Nest, on ground, near fresh water; of twigs, mosses, etc. Eggs, usually 6; pale buff, varying to green; 2.68 by 1.83.

Rare winter visitor. More numerous on Lake Michigan.

Dr. Haymond records it from Franklin County "as numerous in winter" (Ind. Geol. Rept., 1869, p. 223). Mr. Ruthven Deane informs me that a bird of this species was taken at English Lake the latter part of October or early part of November, 1889. Two more were killed there early in November, 1890, after a heavy blow off Lake Michigan. Mr. J. G. Parker, Jr., says it is found on Lake Michigan during the winter months, but is rare. This duck has been taken on the Illinois River (Nelson); at St. Louis, Mo. (Allen); on the Scioto River, near Columbus, O.; at Licking Reservoir; in the vicinity of Cleveland and Sandusky Bay. Dr. J. M. Wheaton, Birds of Ohio, p. 538.)

Subgenus *PELIONETTA* Kaup.

49. (166). *Oidemia perspicillata* (LINN.).

Surf Scoter.

Synonym, SURF DUCK.

Adult Male.—Black, with patch of white on the forehead and another on the nape; none on the wing; bill, orange red, whitish on the sides, with a large circular black base. *Female*.—Smaller; sooty brown;

below, silvery gray; whitish patches on each side of the head; bill, black; feet, dark, tinged with reddish; webs, black.

Length, about 20.00-22.00; wing, 9.25-9.75; bill, 1.30-1.60; tarsus, 1.55-1.85.

RANGE.—North America. Breeds northward from Labrador through British America and Alaska; south in winter in interior to southern Indiana; on coasts to Florida and Jamaica, and Lower California.

Nest, on ground in grass, near water. *Eggs*, 5; pale buff, or pale creamy buff; 2.47 by 1.70.

Rare winter resident on Lake Michigan; of occasional occurrence elsewhere.

An immature specimen was taken by Dr. F. Stein on the lower Wabash River, near Mt. Carmel, Ill., in October, 1875. That same fall Mr. E. W. Nelson says quite a number of specimens were taken on the Calumet marshes, and many others seen. (Birds of N. E. Ill., p. 143.) That is the only year for which I have been able to obtain records. It is, however, given by Mr. H. Nehrling as not uncommon on Lake Michigan. Mr. N. A. Eddy says one specimen was taken at the mouth of the Saginaw River in 1884. It is often quite common in fall migrations. It is frequently taken by the duck hunter, who calls it the "booby-duck." They regard it as unfit to eat, but when taken in fresh water it is excellent eating. (Cook, Birds of Michigan, p. 45.)

On August 23, 1878, I visited Stewart Island, about ten miles to the seaward of St. Michaels. As I neared the island in my kyak, I found the water literally black with the males of this species, which were united in an enormous flock, forming a continuous band around the outer end of the island for a distance of about ten miles in length, and from one-half to three-fourths of a mile in width. As the boat approached them, those nearest began to rise heavily by aid of wings and feet from the glassy surface of the gently undulating, but calm, water. The first to rise communicated the alarm to those beyond, until as far as could be seen the water was covered with flapping wings, and the air filled with a roar like that of a cataract. The rapid vibrations produced in the air by tens of thousands of wings could be plainly felt. In all my northern experience among the water fowl which flock there in summer, I never saw any approach to the number of large birds gathered here in one flock, nor shall I soon forget the grand effect produced by this enormous body of birds as they took wing and swept to sea in a great black cloud, and settled again a mile or so away. (Nelson's Rept. N. H. Coll. in Alaska, p. 81.)

24. GENUS ERISMATURA BONAPARTE.

♂¹. Male, side of head below eyes white; female, side of head and neck grayish-white, with darker stripe from corner of mouth to ear coverts.

E. rubida (Wils.). 50

50. (167). *Erismatura rubida* (WILS.).**Ruddy Duck.**

Synonyms, BLACK JACK, BRISTLE-TAIL, FOOL DUCK.

Male in Full Plumage.—Bill, slaty blue; the nail black; neck, all around, and the upper parts, bright chestnut; the lower parts, silky white, watered with dusky; chin and sides of the head, white; the crown and nape, black. *Female*.—Brown above, finely dotted and waved with dusky; paler and duller below, with sometimes a slight tawny tinge, which also occurs on the sides of the head.

Length, about 13.50-16.00; wing, 5.75-6.00; bill, about 1.50-1.60.

RANGE.—North America, in general south to West Indies and Colombia; breeds throughout its range, from Granada and Guatemala north, at least to Great Slave Lake. No American duck has so extensive a breeding range.

Nest, built to float like a Grebe's or else along the edge of reedy stream or lake, or on drift. *Eggs*, 5-11; white or pale buffy; 2.42 by 1.75. Migrant, usually not common.

Throughout the southern part of the State it appears to be rare. I have one specimen taken near Brookville. Dr. F. Stein reports it from the lower Wabash Valley. Prof. B. W. Evermann notes it as rare in Monroe and Carroll counties. Mr. C. E. Aiken tells me he has seen them abundant on the Calumet River in Indiana.

Mr. Chas. Dury tells me they are known to the hunters at English Lake as "Black-Jacks."

With us they are usually found singly or in small groups by themselves or with the Coots.

This is quite in contrast with their habits in the Southern States, where they congregate in great flocks. They frequent the smaller lakes and more sluggish water courses.

They return from the south late in the spring, usually arriving the latter part of March, and remain through the month.

Mr. H. K. Coale noted two males and a female at Tolleston, Ind., May 9, 1877, and Mr. Ruthven Deane found two males and a female in the red spring plumage at English Lake May 11, 1890.

The latter records indicate that they mate in threes. Is this a case of polyandry? The Ruddy Duck may be found to breed among our marshes.

Mr. Nelson found it breeding in Illinois (Birds Northeast Illinois, pp. 143, 144) and Prof. Cook says the late Mr. W. H. Collins reported taking its eggs (presumably at St. Clair Flats, Mich.) (Birds of Michigan, p. 45.) The stupidity of this duck is well known. Persons are at times permitted to row up to it, when it seems apparently dazed or sleeping.

In the fall they appear about the first of October and depart later in that month or in November. Dr. Wheaton says at this season they are found in flocks of fifteen or twenty.

SUBFAMILY ANSERINÆ. GESE.

25. GENUS CHEN BOIR.

a¹. Plumage chiefly grayish-brown; the rump, usually, and wing coverts, bluish-gray. *C. cærulescens* (Linn.). 53

a². Plumage, in adult, white; primaries black, their coverts gray; in young, grayish and grayish-white.

b¹. Wing 17.00 or under.

C. hyperborea (Pall.). 51

b². Wing over 17.00.

C. hyperborea nivalis (Forst.). 52

51. (169). *Chen hyperborea* (PALL.).

Lesser Snow Goose.

Synonyms, ALASKA GOOSE, WHITE BRANT.

Adult.—Uniform pure white, the head often stained with rusty; primaries black; their bases and coverts dark-gray. *Young*.—Head, neck and upper parts pale grayish, the feathers of the latter with whitish edges and (especially wing coverts and tertials) striped medially with darker; rump, upper tail coverts, tail and lower parts plain white.

Length, about 23.00-28.00; wing, 14.50-17.00 (16.36); bill, 1.95-2.30 (2.15); tarsus, 2.80-3.25 (3.01); middle toe, 2.00-2.50 (2.34).

RANGE.—Pacific Coast to the Mississippi Valley, breeding in Alaska; south in winter from southern Illinois and southern Indiana to gulf coast; southern California. Casually to New England. Northeastern Asia.

Nest, by side of water on ground, of grass and feathers. *Eggs*, 5-8; yellowish-white; 3.13 by 2.12.

Rare migrant throughout the State; much more often seen in spring.

Mr. Nelson thought that this species and the next were found in Illinois in about equal numbers.

In this State and the vicinity of Chicago what reports I have received relate principally to this form. The two birds are similar in appearance, except in size. They are at times found in flocks together

or with other geese; again each kind will be found by itself. I have had them reported in flocks with Blue Geese, Canada Geese and American White-fronted Geese. Reported from Dekalb County (R. W. McBride), Lake County (Meyer), Starke County (Deane). October 18, 1881, a single Lesser Snow Goose was seen near Brookville with a flock of tame geese, and was shot. It was preserved by Mr. E. R. Quick. In spring they rarely appear late in February, usually not until the early part of March, and scatter along through that month, a few remaining in the northern part of the State occasionally into early April.

The earliest spring record I have is from Mr. H. W. McBride, at Waterloo—six geese, February 23, 1890. Prof. W. P. Shannon reports a flock of twenty in the vicinity of Greensburg, March 14, 1895, from which eight were killed. All were immature. The next day a flock of thirty was seen. The latest record I have of it is reported by Mr. C. L. Barber, Laporte, March 30, 1896, and the same year Mr. Eliot Blackwelder saw the last in Cook County, Illinois, April 4.

They are always conspicuous objects when the pure white adult plumage contrasts with the dense black primaries. Whether with a flock of their fellows or notable examples in a flock of darker colored geese, they are certain to be observed.

These, together with their larger relatives and the Blue Goose, are known by many as Alaska Geese. A gentleman one day showed me an Alaskan bone arrow or spear point, which he said had been found in northern Indiana, and stated that for some time he had been puzzled to account for its occurrence there. Then he showed me the sternum of an Alaska Goose, possibly this species, which had been shot in northern Indiana, through which a similar arrow head had pierced and remained firmly imbedded. He had carefully cleaned the sternum and left the head of the projectile as it was found. Thus was solved the problem of the way in which this implement was transported from the borders of the Arctic Sea to the rich fields of northwestern Indiana.

52. (1.9a). *Chen hyperborea nivalis* (FORST.).

Greater Snow Goose.

SYNONYMS, ALASKA GOOSE, WHITE BRANT.

Same colors as last.

Length, 20.00-26.00; wing, 13.75-15.50; culmen, 1.50-1.70; tarsus, 2.30-3.00.

RANGE.—North America, breeding far north (east of Mackenzie Basin), and migrating south in winter, chiefly along the Atlantic coast to Gulf coast and Cuba.

Eggs, unknown.

Rare migrant. This species and the preceding are not usually distinguished. Where it has been noted it would seem to be found less often than the smaller form.

Mr. E. J. Chansler has several times seen Snow Geese in Knox County, which he referred to this species. About 1867 he saw a flock of eighteen. October 25, 1896, he saw a single specimen, and December 12, 1896, he saw another Snow Goose flying over in a flock of Hutchins' Geese. Mr. Chas. Dury has reported this goose from Chalmers. In the spring of 1897, while calling upon Mr. Mortimer Levering, at his country home near Lafayette, my attention was drawn to three geese, one of which was a Snow Goose, which had been shot from a flock near Morocco in 1892. It was only winged, and came into the possession of Mr. Levering, where it had become quite tame.

Sir John Richardson, in his "Fauna Boreali Americana," speaks of the abundance of these birds in the far north, where they breed. The young fly in August, and by the middle of September all have departed southward.

"The Snow Goose feeds on rushes, insects, and in autumn on berries, particularly those of the *Empetrum nigrum*. When well fed it is a very excellent bird, far superior to the Canada Goose in juiciness and flavor. It is said that the young do not attain their full plumage before the fourth year, and until that period they appear to keep in separate flocks. They are numerous at Albany Fort, in the southern part of Hudson Bay, where the old birds are rarely seen, and on the other hand, the old birds in their migrations visit York Factory in great abundance, but are seldom accompanied by the young."

Both of the Snow Geese are known as "White Brant."

53. (169). *Chen caerulescens* (LINN.).

Blue Goose.

Synonyms, ALASKA GOOSE, BLUE-WINGED GOOSE, BLUE BRANT.

Head and upper neck and sometimes rump and back part of belly, white; back of neck often with more or less distinct black stripe lengthwise; greater wing coverts and secondaries (including tertails) edged with white; rest of plumage mostly grayish-brown, the rump (usually) and wing coverts, bluish-gray.

Young.—Similar to adult, but head and neck uniform deep grayish-brown, only the chin being white.

Length, 26.50-30.00; wing, 15.00-17.00; culmen, 2.10-2.30; tarsus, 3.00-3.30.

RANGE.—Interior of North America, east of Rocky Mountains, breeding on the eastern shores of Hudson Bay; migrating south in winter through the Mississippi Valley to the Gulf coast; occasional on Atlantic Coast.

Nest and Eggs, unknown.

Rare migrant. Dr. Rufus Haymond first identified this goose in Indiana. (Ind. Geol. Rept., 1869, p. 231.) Prof. B. W. Evermann found three specimens in the Terre Haute market April 2, 1887, which were killed about eighteen miles south of that city, in Sullivan County. A few days later he saw another of these geese in the city market.

Mr. Chas. Dury reports it from Chalmers and English Lake. Mr. J. O. Dunn informs me that there is a mounted specimen in the Hyde Park (Chicago) High School, labeled Wolf Lake, Indiana. December 18, 1884, he also reports seeing twelve specimens in South Water Street market, Chicago, March 29, and others again April 7, 1894, all of which had been killed in Illinois. Mrs. Jane L. Hine states that a taxidermist at Hudson, Steuben County, has a Blue Goose that he says was shot early in the spring of 1891 in a swamp not far from Stony Lake, Dekalb County. Mr. Mortimer Levering, of Lafayette, has two of these geese, which were shot and crippled from a flock near Morocco, Newton County, in 1892. He has kept them, and one Snow Goose taken at the same time, for five years, and they have become quite tame.

Dr. McChesney, in his account of the birds of northern Dakota, says they are found there, in the fall, mixed with flocks of Snow Geese, but he never observed them in the spring. As the above references will show, most of those noted in Indiana and the vicinity of Chicago have been seen in the spring.

26. GENUS ANSER BOISSON.

α'. Fore part of head and feathers at base of bill white, or fore part of head dusky and nail of bill, black. **A. albifrons gambeli** (Hartl.) 54

54. (171a). Anser albifrons gambeli (HARTL.).

American White-fronted Goose.

Synonyms, LAUGHING GOOSE, GRAY BRANT.

Adult.—Fore part of head and forehead, white, bordered behind with blackish; upper tail coverts, sides of rump and crissum, white; under parts whitish blotched with black; rest of head and neck grayish-brown, shading lighter as it joins the breast; back dark gray, the feathers tipped with brown; greater coverts and secondaries bordered with

whitish; primaries and coverts edged and tipped with white; bill pink, pale lake or carmine; nails, white; feet, yellow; claws, white.

Length, 27.00-30.00; wing, 14.25-17.50; bill, 1.80-2.35; depth of upper mandible at base, .90-1.20; width, .85-1.05; tarsus, 2.60-3.20.

RANGE.—North America (rare on the Atlantic Coast), breeding far northward; in winter south to Cape St. Lucas, Mexico and Cuba.

Nest, a depression in the sand beside fresh water. Eggs, 6-7; greenish-yellow; 3.10 by 2.07.

This goose is a rare migrant in Indiana.

There is a male in the collection of the Cuvier Club, Cincinnati, O., that was killed in the spring at English Lake. Mr. Ruthven Deane has seen it at the same place. Mr. C. A. Stockbridge has a specimen in his collection, taken at Davis, Ind., in 1874. A goose of this species was killed at Peru, April 17, 1891. It was mounted by Mr. J. E. Beasley for Jos. Andre, of that city. Mr. Chas. L. Barber saw two in the market at Laporte April 4, 1894. They were killed on the Kankakee River, near that place. Mr. J. O. Dunn saw some in the Chicago market, from Illinois, April 7, 1894.

Dr. Langdon notes its occurrence in the vicinity of Cincinnati, and it has been noted a few other times in Ohio. (Wheaton, Birds of Ohio, pp. 517, 518.) It is rare in Michigan. (Cook, Birds of Michigan, p. 46.) In 1876 Mr. Nelson gave it as a very abundant migrant, occurring in large flocks in Illinois. (Birds of Northeastern Illinois, pp. 136, 137.) Mr. Ridgway says nothing of its being even common in 1895, but notes that it frequents open prairies or wheat fields, where it nibbles the young and tender blades, and cornfields, where it feeds upon the scattered grains.

"The mating season is quickly ended, and on May 27, 1879, I found their eggs at the Yukon mouth. From this date on until the middle of June fresh eggs may be found, but very soon after that date the downy young begin to appear. The geese choose for a nesting site the grassy border of a small lakelet, a knoll grown over with moss and grass, or even a flat, sparingly covered with grass. Along the Yukon, Dall found them breeding gregariously, depositing their eggs in a hollow scooped out in the sand. At the Yukon mouth and St. Michaels they were found breeding, scattered in pairs over the flat country. Every one of the nests examined by me in these places had a slight lining of grass or moss, gathered by the parent, and upon this the first eggs were laid. As the complement of eggs is approached the female always plucks down and feathers from her breast until the eggs rest in a warm, soft bed, when incubation commences. The eggs vary considerably in shape and size. Some are decidedly elongated; others

are decidedly oval. In color they are a dull white, but ordinarily present a dirty brown appearance from being stained in the nest.

The young are pretty little objects, and are guarded with the greatest care by the parents, the male and female joining in conducting their young from place to place and defending them from danger." (Nelson, Report Nat. Hist. Coll. in Alaska.)

27. GENUS *BRANTA* SCOPOLI.

a¹. Head black; cheeks and throat white.

b¹. Larger; length 35.00 or over.

B. canadensis (Linn.). 55

b². Smaller; length under 35.00.

B. canadensis hutchinsii (Sw. & Rich.). 56

a². Throat black, or brownish black; white streaks or spots on each side of neck.

B. bernicla (Linn.). 57

*55. (172). *Branta canadensis* (LINN.).

Canada Goose.

SYNONYM, COMMON WILD GOOSE.

Adult Male.—Head and neck black, with a broad white patch on throat, extending up into each cheek; tail and quills black; upper tail coverts white; upper parts brownish, the feathers with lighter tips; below, light brownish-gray, almost white on crissum, all the feathers with lighter edges; bill and feet, deep black.

Length, about 35.00-43.00; wing, 15.60-21.00; bill, 1.58-2.70; tarsus, 2.45-3.70.

RANGE.—North America; breeds from Indiana, Illinois, Tennessee northward from Mackenzie Valley to Atlantic Coast. Winters from southern limit of breeding range south to Gulf States and into Mexico.

Nest, usually in a hollow in the sand, lined with down, and a few sticks around the edge. Along the upper Missouri it breeds in trees. (Coues, B. N. W.) *Eggs*, 4-7; pale dull greenish; 3.55 by 2.27.

Common migrant; sometimes winter resident in the northern part of the State; resident in some numbers. They often breed. Formerly these geese were much more abundant than now, but they are still common during the migrations among the lakes and marshes of northern Indiana.

This is the common Wild Goose. Almost every mild winter more or less of them remain in one part, if not another, of the lower Wabash Valley. Mr. E. J. Chansler says a few years ago the prairies of Knox County were covered with these geese many days during the winter. They could be seen by thousands. Now they are seldom met with. The winters of 1886-7 and 1892-3 they remained in the valley of the

Whitewater. The latter winter a small flock remained in the vicinity of Brookville, through zero weather, until the last were killed, some time in January. The winter of 1888-89 they remained in some numbers on the Kankakee all winter.

Often they begin moving with the January thaw, and by February, some years, if the waters are open, are to be found throughout the State.



Canada Goose.

Their forwardness sometimes brings them to grief. Occasionally cold weather follows their movements, and they are compelled to pass a season of severity while in the midst of their migrations. March 9, 1889, and February 14, 1891, the marshes at English Lake were covered with ice, and the geese were sitting on the ice. February 22, 1894, the Tolleston marshes were covered with ice, and geese sat on the ice. (Deane.)

These geese are among the first birds to move. They do not follow the course of streams, but go over wood and meadow, river and town, attracting the watcher by the flight, in single file or two lines, meeting in a point, and calling the attention of the inattentive by the melodious *honk-honk* of the old gander who leads the van. Thus, theirs

becomes the most notable of the early bird movements, and they are harbingers of spring. Their coming and going is the wonder of all who behold them, and the impression they make upon the young mind is lasting.

They continue the spring migration through March, and usually have passed the southern part of the State by the middle of that month, though Mr. E. J. Chansler has noted them as late as April 2 (1897). In the vicinity of Lake Michigan they often continue abundant up to that date. They are so reported April 2, 1893, at Kouts, Ind., and common April 2, 1885. (Parker.) About this time, however, the migrants leave, and only those who remain to breed are found. In years gone by many more bred with us than do now.

Thirty years ago it was not uncommon to find upon the upland meadows of Franklin and other southern counties, where great flocks of these geese had stopped during the March migrations, numbers of eggs that had been dropped by them.

They still breed in some numbers in the Kankakee region and less frequently in other favorable localities, notably Dekalb County (J. O. Snyder), Steuben County, at Twin Lakes of the Wood (Mrs. J. L. Hine), Laporte County (C. L. Barber). They evidently begin nesting between April 15 and May 1, as nests with the full complement of eggs are usually found from the first to third week in May.

These geese are often domesticated. In our State the farmers in some localities where they breed, get the eggs and hatch them under a hen. Mr. L. T. Meyer informs me of one farmer in Lake County who found a nest containing six eggs, built upon a muskrat house. He took the eggs, and the hen under which he set them hatched four goslings. These he kept for a number of years, and they bred every year. In this connection I desire to refer to an account of domesticated Canada Geese by Mr. Wm. Dutcher, in the *Auk*, January, 1885, p. 111. The notes are given from the experience of Capt. Lane, of Shinnecock Bay, Long Island, and from these I quote the following concerning their breeding habits: "They make their nests of dried grass, raising them about twelve inches from the ground. They feather them when they begin to lay, which is about May 1. None lay until three years old. The first season four eggs are laid, five the second, and when older, six or seven. A goose never has more than one mate, but while the goose is sitting the gander never leaves her, though he never sits on the nest. The time of incubation is four weeks. The young when hatched are strong enough to take care of themselves; that is, they eat grass and walk and swim as soon as they get dry. They will eat meal on the

second day. They are in the down four weeks and are fully grown in six weeks. When swimming, the gander goes ahead, the young next and the goose follows invariably."

The following records taken from English Lake, are given: The first was killed in 1881, February 16; 1886, March 17; 1887, March 13; 1889, common March 9, had been present several days; 1891, first seen February 14; 1892, February 27; 1894, February 22 at (Tolleston, Lake County); 1896, February 2.

They arrive on our marshes in September, but in the southern part of the State are seldom seen until after the middle of October. They remain until the first cold snap, then the great body pushes on towards the Gulf of Mexico.

***56. (172a). *Branta canadensis hutchinsii* (Sw. & Rich.).**

Hutchin's Goose.

Synonyms, LESSER CANADA GOOSE, LITTLE WILD GOOSE.

Similar to last species; much smaller and tail feathers usually 14 or 16.

Length, about 25.00-34.00; wing, 14.75-17.75; bill, 1.20-1.90; tarsus, 2.25-3.20.

RANGE.—North America; breeds in Arctic regions and Alaska, where center of abundance is along lower Yukon, and thence south to the Kuskokwim. (Nelson.) Winters in southern United States.

Nest, similar to last. Eggs, 4-6; white; 3.18 by 2.10.

Migrant and occasional winter resident; formerly common; now rarely seen. These geese are commonly called by hunters "Brant."

In 1879 Dr. A. W. Brayton noted it as common. (Trans. Ind. Hort. Soc., 1879, p. 178.) Mr. E. J. Chansler informs me that they were formerly common in Knox County, especially in the fall. In 1891 he saw a large flock of them in Gibson County. They were quite common the winter of 1893-4 and the fall of 1896. Mr. Chansler says even when they are not near enough to be distinguished by their smaller size, they can be recognized by their voices, which are finer and more resembles that of the domestic goose. He says he has often seen them flying with Canada Geese and with Mallard Ducks. They appear in the northern part of the State in September, and reach the lower Wabash Valley from October 25 to 27, and the length of their stay depends upon the weather.

In spring they go north in March. The last record I have is from Knox County, March 18, 1897.

57. (173). *Branta bernicla* (LINN.).**Brant.**

Head entirely black; middle of neck with a patch of white streaks on each side; upper parts brownish-gray, the feathers narrowly tipped with grayish-white; lower parts pale grayish, in conspicuous contrast with black of chest, and gradually fading into the white of anal region and crissum.

Length, 23.50-30.50; wing, 12.30-13.60; bill, 1.20-1.50; tarsus, 2.10-2.40.

RANGE.—Northern parts of Northern Hemisphere; in North America chiefly on the Atlantic coast; rare in the interior or away from salt water. Breeds only in Arctic Circle.

Nest, a hollow in the sand, lined with feathers and down. *Eggs*, 4-6; grayish or dirty white; 2.92 by 2.02.

Accidental visitor.

This goose prefers the sea, and does not wander far from tide water. It is, however, occasionally found in the interior, where it has been reported from Ohio, Illinois and Wisconsin.

Dr. Rufus Haymond reported it from the Whitewater Valley. (Proc. Phil. Acad. Nat. Sci., 1856, p. 296, and Ind. Geol. Rept., 1869, p. 232.) Mr. O. B. Warren informs me that a specimen was taken at Albion, Mich., by E. M. Griffin in the winter of 1884, and is now in the collection of the college there. There are also other Michigan records. (Cook, Birds of Michigan, p. 47.) Prof. Cooke says during the winter of 1883-4 this species was represented from Illinois southward by a few rare visitants. (Bird Mig. Miss. Valley, p. 78.)

SUBFAMILY CYGNINÆ. SWANS.

28. GENUS *OLOR* WAGLER.

*a*¹. Bill black with a yellow spot; the distance from the eye to the nostril much greater than from the latter point to the tip of bill.

O. columbianus (Ord.). 58

*a*². Bill black, no yellow; the distance from the eye to the nostril not greater than from the latter point to tip of bill.

O. buccinator (Rich.). 59

58. (180) *Olor columbianus* (ORD.).**Whistling Swan.**

Pure white; head often stained with rusty; bill and lores, black, usually the latter with small yellow spot; iris, dark brown; feet, black.

Length about 54.00; extent, 84.00; wing, 21.00-22.00; bill, 3.80-4.20; tarsus, 4.00-4.32.

RANGE.—The whole of North America, breeding far north; Commander Islands, Kamtchatka. Accidental in Scotland. Winters in Indiana and Illinois and south to Gulf of Mexico.

Nest, in a tussock of grass near the water, often surrounded by it so closely that the bird while sitting on the eggs has her feet submerged. **Eggs,** 2-5; white, often stained with brown; 4.19 by 2.72.

Not common migrant and rare winter resident.

They spend the summer far to the north of the United States, breeding at least south to a line from Hudson Bay to Alaska, and not in the United States.

They migrate late in the fall; November seems to be their month, and I find no earlier records at hand for the Ohio Valley or the lower lake region. Nov. 15, 1894, one was taken at Long Lake, Wabash County. (Ulrey and Wallace, Proc. I. A. S., 1895, p. 150.)

November 19, 1896, Prof. E. L. Mosely reports it from Sandusky, O., and adds: "It is said to have been seen earlier."

One killed at Mason, Mich., November 28, 1878. It has also been taken in Michigan in winter. Prof. A. J. Cook informs us that E. A. Lockwood took two in the month of December at South Haven. (Birds of Michigan, pp. 47, 48.) My friend, Mr. B. T. Gault, informs me he saw nine swans, species unknown, near Thayer, Newton County, Indiana, January 18, 1892. Seven swans were seen on Swan Pond, Daviess County, in the spring of 1897. (Chansler.)

The return journey to their breeding grounds is made in March and early April. They are more often seen in spring than fall, sometimes being not uncommon at that time in the northern part of the State. Mr. Nelson notes that they were unusually numerous in the spring of 1876 in the vicinity of Chicago. (Birds N. E. Illinois, p. 136.)

The earliest spring record is that of a specimen in my collection, shot by Stephen McKeown, in Franklin County, March 7, 1888.

Mr. L. T. Meyer reports it from Lake County March 8, 1888; Mr. Ruthven Deane saw nine at English Lake March 11, 1894, but did not identify them.

Mr. R. B. Trouslot informs me that there is a specimen in the High School at Valparaiso that was taken in Porter County March 22, 1887.

Prof. Evermann says that it is more often seen in Carroll County in spring. There is a specimen in the collection of Cuvier Club, Cincinnati, from Indiana (Dury); also, one in the State Geologist's office at Indianapolis from Decatur County. Mr. Parker saw five swans flying over Calumet Lake, Illinois, and about fifty on the Kankakee River at Kouts, Ind., March 31, 1894, but did not determine the

species. The latest record for the State is the second specimen noted in Dekalb County, April 1, 1890. (H. W. McBride.)

Formerly, when these birds were more abundant, they migrated in flocks of twenty or thirty, and sometimes as many as fifty, high in air in two converging lines, like a flock of Canada Geese. It is said there is not the noticeable movement of the wings as with geese, yet when traveling at their ordinary gait, with the wind in their favor, it is estimated they travel at least a hundred miles an hour. Like Wild Geese, they move regardless of the trend of water courses. In winter they are said to be very common some years on the south Atlantic and Gulf coasts. Mr. Dall notes that they reach the Yukon about May 1, and says they descend that stream instead of going up it, as most of the geese do at this season. Mr. E. W. Nelson notes his experience in finding a nest of this swan. "On June 14, 1880, a swan was seen flying from the side of a small pond on the marsh near St. Michaels, and a close search finally revealed the nest. The eggs were completely hidden in loose moss, which covered the ground about the spot and in which the bird had made a depression by plucking up the moss and arranging it for the purpose. The site was so artfully chosen and prepared that I passed the spot in my search, and one of my native hunters coming close behind, called me back, and thrusting his stick in the moss, exposed the eggs." (Nat. Hist. Coll. in Alaska, p. 92.)

***59. (181). *Olor buccinator* (Rich.).**

Trumpeter Swan.

Pure white; head, sometimes neck and lower parts, stained with rusty; feet, bill and lores, black, latter without yellow spot.

Length, 60.00-66.00; extent, 96.00-near 120.00; wing, 21.00-27.50; bill, 4.30-4.70; tarsus, 4.54-4.95.

RANGE.—Chiefly the interior of North America, from the Gulf coast to the fur countries, breeding from Iowa and the Dakotas (formerly Indiana) northward; west to the Pacific Coast; rare or casual on the Atlantic.

Nest, on high dry ground near water, of grass and feathers. *Eggs*, 2-6; white; 4.46 by 2.92.

Rare migrant and probably winter resident; not seen as often as last species. Formerly summer resident and bred.

Its breeding range extends farther south than the last mentioned swan, reaching into the United States as far as Iowa and Minnesota, and extending from northwestern Hudson Bay (Hearne) to the Pacific Coast and northward to Alaska and beyond the Arctic Circle

(Richardson.) Mr. T. H. Ball informs me that formerly swans bred in the Kankakee marshes in Lake County.

They migrate almost wholly through the Mississippi Valley. In the fall it appears sooner than the other species. Although not identified, the swans observed by Mr. J. G. Parker, Jr., at Calumet Lake, Ill., in September, 1887, were probably this species. It, too, is less frequently observed in fall, and may be a winter resident. Dr. F. W. Langdon notes one specimen of this species seen on the Ohio River near Cincinnati, in December, 1876, which was taken, and is preserved in the collection of Max Wocher, in that city. (Jour. Cin. Soc. Nat. Hist., I, 1879, p. 185.) The swans observed by Mr. Gault in January and noted under the last species may belong to this. Prof. Cooke notes that it sometimes winters north to Illinois. The larger part, however, pass farther south, where it is abundant in winter along the Gulf coast.

The earliest migratory record in the spring is February 22, 1890. On that day Mr. H. W. McBride identified a flock of eight at Waterloo, Dekalb County.

The same date, February 22, in 1894, a gentleman at Valparaiso shot one out of a flock of seven as they were "coming in" to alight in a spring hole. The day was very cold and much snow was on the ground. The bird weighed $24\frac{1}{2}$ pounds. The following are the measurements: Length, 50.00; extent, 83.00; width, 21.00; tail, 8.00; tail of 24 feathers. This specimen is now in the collection of Mr. Ruthven Deane, Chicago. Dr. Vernon Gould informs me that six or eight were shot near Rochester in March, 1890. He dissected one, and is positive of the identification. In the spring of 1882 a flock of eight alighted on Cedar Lake, Lake County, and three were shot with a rifle. (L. T. Meyer.) Three were noted at Laporte March 24, 1896. (Chas. Barber.) Mr. J. P. Feagler saw two at Waterloo March 18, 1897, and saw others March 22. Prof. Evermann notes that it has been taken in Carroll County. (The Auk, October, 1888, p. 346.)

It is a grand bird, weighing often as much as thirty pounds and sometimes nearly forty, with a spread of wings of eight to nearly ten feet—much greater than any other American bird, excepting only the Condor and the California Vulture, both of which are considerably inferior in weight. Its eggs, averaging about 4.46 by nearly 3.00 inches in size, are so large that one of them is said to be a sufficient meal for a moderate man. Although so large, it is swift of wing, and Hearne states that in his opinion it is more difficult to shoot when flying than any other bird.

"The name Trumpeter is derived from its ringing note, much more sonorous than that of the common species (*O. columbianus*), and said

to resemble a blast from a French horn." (Ridgway, Birds of Illinois, p. 107.)

The extreme length of the trachea (windpipe) and its peculiar foldings attract the attention of those who attempt the dissection of one of these swans.

E. ORDER HERODIONES. HERONS, STORKS, IBISES, ETC.

SUBORDER IBIDES. SPOONBILLS AND IBISES.

XI. FAMILY PLATALEIDÆ. SPOONBILLS.

Characters same as family.

AJAJA. 29

29. GENUS AJAJA REICH.

♂¹. Plumage chiefly white; back and wings rose pink. *A. ajaja* (Linn.). 60

60. (183). *Ajaja ajaja* (LINN.).

Roseate Spoonbill.

Adult.—Head and throat bare; neck, back and breast, white; tail, orange-buff, the shafts deep pink; rest of plumage, pale rose pink; lesser wing coverts, upper and undertail coverts, carmine. *Immature*.—Similar, but without carmine on wing and tail coverts, and tail pinkish. *Young*.—Similar; head and throat feathered; tail and carmine-colored parts pink.

Length, about 28.00-35.00; wing, 14.10-15.30; bill, 6.20-7.15; greatest width of bill, 2.00-2.20; tarsus, 3.75-4.65.

RANGE.—America, from Patagonia to Illinois and Indiana; most numerous in the tropics. Breeds in Louisiana and Florida, and south.

Nest, on trees or in marshes, in tropics, of sticks. *Eggs*, 3-4, rarely 7; white or buffy white; 2.57 by 1.73.

Accidental visitor.

Mr. E. J. Chansler writes me that he is informed by Mr. H. M. Smith that in the spring of 1856 Mr. H. Sones shot two of these beautiful birds in a swampy place a few miles east of Vincennes on the line of the B. & O. S.-W. R. R. Mr. Sones was collecting for some eastern or foreign institution, and was living with Mr. Smith when he obtained these specimens. If they are in existence it would be interesting to know where they are. Prof. B. W. Evermann, from investigations he has made, is satisfied that some of these birds were seen and one killed near Terre Haute several years ago. A Roseate Spoon-

dates accompanying them are for July, August, September and October, the earliest being July 30 (1887) and the latest October 30 of the same year. Dr. Wheaton mentions one being taken in spring ten miles west of Cleveland. (Birds of Ohio, p. 497.) The first account of the occurrence of these birds in the State is given by Dr. Haymond (Proc. Phila. Acad. Nat. Sci., 1856, p. 295), in which he says: "The first day of August, 1855, a large flock of these birds made their appearance in this neighborhood. They remained along the river and the White-water Canal for about a month or six weeks. A son of one of my neighbors broke the wing of one of them and caught it. After keeping it three or four weeks, feeding it upon fish, he gave it to me. I kept it until the first of November, when it fell a victim, as many another bipped has done, to its appetite. Some mackerel had been placed to soak upon a table in the back yard, one of which he stole and ate, and upon the evening of the next-day, died in convulsions." Dr. Haymond also refers to this in Indiana Geological Report, 1869, p. 229.

I was very much surprised in the winter of 1889-90, to have brought to me by my friend, Mr. Edw. Hughes, the skull of a Wood Ibis, the name of which he desired to know. He said it was the skull of a bird which had been killed about three miles south of Brookville, and was preserved as a curiosity in the family of Mrs. St. John. At my request he inquired the date and facts of its capture. He was informed that it was one of a number which were seen along the river in the summer of 1855 or 1856. This was perhaps one of the same flock of which I have before spoken. Dr. F. Stein informs me that he saw a pair of Wood Ibises at "Little Chain," about ten miles west of Mt. Vernon, about 1874 or 1875. One was shot by a Mr. Harmon at "Maple Swamp," in Carroll County, July 30, 1887. Mr. C. E. Newlin informs me that the specimen is in the possession of Dr. O. A. J. Morrison, of Middle Fork, Ind. Mr. Ridgway has seen it in Knox and Gibson counties several times, and, concerning its occurrence there, remarks: "The Wood Ibis occurs numerous every summer along the Wabash, and while it may not breed, I think that it does." In a letter to Prof. Evermann, he says: "I remember, years ago, seeing these birds occasionally, soaring in circles, high in air, above the Wabash River, at Mt. Carmel, the season, I think, being midsummer. Again, either in summer or early fall, I started a large flock which had been perching on the branches of a large dead sycamore tree overhanging the bank of White River Pond, just below the mouth of the White River, but did not get any specimens. The species, to my certain knowledge, occurs more or less plentifully, at times, at the Cypress Pond, in the southwestern corner of Knox County (Indiana). but, owing to the circumstances that I

am so little in that part of the country, I am unable to state whether they occur there regularly or not. I believe that the species formerly bred in small numbers in that portion of the Wabash Valley, though I have no distinct evidence upon which to base this supposition. Most of the birds now seen there, however, occur late in summer (August and September), a considerable portion of them, perhaps a majority, being young birds of the year."

Mr. Ridgway further says that he saw at "Mt. Carmel the dried head of one that was killed by a hunter at the Cypress Pond in Knox County," and that he has been reliably informed of others having been killed there.

Prof. B. W. Evermann says: "Last September (1888) I saw a mounted specimen in a store window at Mt. Vernon, Ind., and, upon inquiry, learned that it was shot by a fisherman, Dexter Short, about October 30, 1887, at Hovey's Lake, Posey County, Indiana. There were about thirty-five or forty in the flock, 'the first ever noticed in the county,' according to the fisherman. They remained in the vicinity for four or five weeks, and then disappeared. Several of them were killed, but I could learn of but one that was preserved. It is now in the possession of Mr. John C. Leffel, of Mt. Vernon. On September 11, 1888, while engaged for the United States Fish Commission in exploring the Wabash River, I had the good fortune to come upon a flock of nine Wood Ibises at Mackey's Ferry, ten miles west of Mt. Vernon. They were sitting in the tops of two dead trees, just across the river on the Illinois side, and remained there during the entire time of our stay at the Ferry—from about 8 to 11 A. M. In addition to these, I find the following general references to its occurrence in Indiana: An old hunter of this city (Terre Haute), in whom I have confidence, tells me that his father shot a Wood Ibis several years ago from a flock of several at the old reservoir south of Terre Haute. From the description given by the hunter, I am quite certain that he was not mistaken. I may add that inquiry among people in Posey, Gibson, and Knox counties seems to show that it is a very rare bird there—one that is not often seen, except by those fellows who are wont to prowl around secluded ponds, and wade cypress swamps, looking for the unusual among animate things."

Mr. Fletcher M. Noe informs me that in the collection of the late Dr. G. M. Levette, which came into his possession, were some skulls of Wood Ibises labeled "Indiana," 1872. Mr. Noe has very kindly placed in my collection a skull from the same source, which he assures me was labeled "Indiana, 1874." Mr. E. J. Chansler informs me that Dr. Smith, of Bicknell, spoke to him of a "Bald Ibis," which may have

been this bird. He also writes that Mr. Balmer, a florist and taxidermist at Vincennes, had sent to him, in 1892, a live Wood Ibis, which had been caught in a trap on Little Swan Pond, Knox County. After a day or two it escaped.

"The Wood Ibis is a remarkable and interesting bird. In its general size, shape and color, it might be likened to a crane, being about four feet long, and standing still higher when erect; white in color, with black-tipped wings and back tail. The head is peculiar, being entirely bald in the adult bird, and having an enormously thick, heavy bill, tapering and a little decurved at the end. In Florida it is sometimes called the 'Gannet.' On the Colorado it is known as the Water Turkey. The carriage of the Wood Ibis is firm and sedate, almost stately; each leg is slowly lifted and planted with deliberate precision before the other is moved, when the birds walk unsuspecting of danger. I never saw one run rapidly, since on all the occasions, when I have been the cause of alarm, the bird took wing directly. It springs powerfully from the ground, bending low to gather strength, and for a little distance flaps hurriedly with dangling legs, as if it was much exertion to lift so heavy a body. But fairly on wing, clean of all obstacles, the flight is firm, strong and direct, performed with continuous, moderately rapid beats of the wing, except when the birds are sailing in circles, as above noted. When proceeding in a straight line the feet are stretched horizontally backward, but the head is not drawn closely in upon the breast, as is the case with Herons, so that the bird presents what may be called a top-heavy appearance, increased by the thick, large bill.

"The eggs of the Wood Ibis are like Herons', in being nearly ellipsoidal, but differ from them, as well as those of the Bay Ibis, in color, which is uniform dull white, without markings. The shell is rather rough to the touch, with a coating of softish, flaky, calcareous substance. A specimen that I measured was exactly $2\frac{3}{4}$ inches in length by $1\frac{1}{2}$ in breadth. Two or three are said to be a nest complement." (Dr. Coues, Birds N. W., p. 513.)

SUBORDER HERODII. HERONS, EGRETS, BITTERNS, ETC.

XIV. FAMILY ARDEIDÆ. HERONS, BITTERNS, ETC.

α^1 . Tail feathers, 10, very short; outer toe shorter than inner.

b^1 . Wing over 10.

b^2 . Wing under 10.

α^2 . Tail feathers, 12, rather long; outer toe not shorter than inner.

BOTAURUS. 32

ARDETTA. 33

c¹. Bill long and slender, at least five times as long as its depth at base.

ARDEA. 34

c². Bill rather short and thick, four times as long as depth at base or less.

NYCTICORAX. 35

SUBFAMILY BOTAURINÆ. BITTERNS.

32. GENUS BOTAURUS HEERMANN.

a¹. Size, large; sexes alike; young similar.

b¹. Wing over 9.50; body variegated with various shades of brown.

B. lentiginosus (Montag.). 63

*63. (190). *Botaurus lentiginosus* (MONTAG.).

American Bittern.



American Bittern.

Plumage of upper parts, singularly freckled with brown of various shades, blackish, tawny, and whitish; neck and under parts, ochery or tawny-white, each feather marked with a brown, dark-edged stripe; the throat line, white, with brown streaks; a velvety-black patch on each side of the neck above; crown, dull brown, with buff superciliary stripe; tail, brown; quills, greenish-black, with a glaucous shade, brown tipped; bill, black and yellowish; legs, greenish; soles, yellow.

Length, 24.00-34.00; wing, 9.80-12.00; bill, 2.50-3.20; tarsus, 3.10-3.85.

RANGE.—Temperate North America north to Hudson Bay. Breeds chiefly north of the latitude of the mouth of the Ohio River to about 60°. Winters from south Indiana and Illinois to Guatemala and West Indies.

Nest, in swampy places on the ground. Eggs, 3-5; brownish-drab; about 2.00 by 1.50.

Regular migrant; tolerably common; summer resident in suitable localities, especially in the northern part of the State, where, in some places, it breeds commonly. In mild winters it sometimes remains among the ponds and swamps of the lower Wabash Valley.

There the last late migrants find their way in November, and Mr. E. J. Chansler has reported them in Knox County through December (1883), and in January.



Head of American Bittern. Natural size.

The Bittern is much more common during migrations some years than others. To the unobserving, even in the vicinity of its favorite haunts, it seems to be of unusual occurrence, while throughout the hilly and rolling land of southern Indiana, and the better drained middle portion of the State, where it only occurs during migrations, the occasional one seen tells to most persons no story of the unseen multitude that has passed over to or from their reedy summer homes. To them it is a rare and curious bird.

Some years the migrations begin in March. The year 1893 was the earliest for Bittern movements in twenty years observation. Prof. W. S. Blatchley found it at Terre Haute March 22, and the first arrived at Greensburg March 23 (Shannon).

In 1885 the first was seen at Brookville April 3, and in 1888 at Vincennes April 3 (Balmer). While it occasionally reaches the vicinity of Chicago by April 10 (Parker), its record at Petersburg, Mich., April 7, 1886 (Trombley) is the earliest within the district noted at that latitude. Usually, however, it is found throughout southern Indiana between April 5 and 25, though sometimes one is to be seen early in May, and in the northern part of the State April 15 to May 10.

They nest on the ground in marshes, the nests being sometimes surrounded by or floating in water. It does not associate with other Herons, and never breeds in colonies.

Dr. Morris Gibbs tells us it utters three kinds of notes. Two of these are loud sounding, and one, a low, guttural utterance, seldom heard, unless one is near the bird when it is given. He says: "The love song is singular in the extreme, and when once heard is never to be forgotten. It is performed and uttered, for the movements in uttering the noise are as singular as the notes, invariably when the bird is standing in the marsh. The sounds so nearly resemble the words *plum pudden* that the bird has received this name. These syllables are repeated from four to eight times, generally six or seven times. The accent is on the *pud*, the final syllable, *den*, being less distinct than the other. The sounds coming from the marsh are mysterious, and seem almost unearthly. Not like the notes of any other birds of Michigan, they are easily learned, and once heard are never to be forgotten. The other name of Stake Driver is also earned by its peculiar, well-defined notes, *ka, whack, ka, whack*, uttered like the others, in a most methodical and apparently strained manner.

The bird, I believe only the male, when uttering either of its peculiar songs, has a most remarkable series of movements to go through, which are ludicrous in the extreme to the observer, though seriously, and I doubt not pompously, performed by *Botaurus* in his efforts at propitiating his loved one, or later in acknowledging his success as a benedictine boss of the marsh." (O. & O., Vol. XIV, 1889, p. 120.)

In the most common illusions to the spring song of the Bittern it is called "booming." Others think its vocal performance at times resembles the noise made by an old wooden stock pump.

The nesting begins soon after arrival and continues through May and June. Mr. Ruthven Deane tells me of finding a nest containing four quite fresh eggs at English Lake, June 10, 1888. The nest was a loose structure of broken cane, floating on the water, built about one foot high. A large snapping turtle (*Chelydra serpentina*) was on the side of the nest, evidently with the intention of capturing the eggs or sitting bird, who was sitting unconcerned. Mr. C. E. Aiken found it breeding abundantly along the Calumet River in May, 1871. It has also been reported as breeding in the following counties: Lake (Meyer, Toppan, Parker), Knox and Gibson (Ridgway), Porter (Byrkit), Vigo (Evermann), Boone (Beasley), Laporte (Barber), Dekalb (Feagler, H. W. McBride), Wabash (Bell), Steuben and Lagrange (H. W. McBride).

They live upon fish, frogs, lizards, crawfish, insects, meadow mice and such other food as is found in the marshes and wet meadows.

The southward migration begins in August. They were very common at English Lake August 8, 1897. (Deane.) I have taken it in

Franklin County August 18, 1896. They keep stringing along through September, October, and some years, the greater part of November. Mr. Beasley noted five in Boone County November 8, 1894, and Prof. W. P. Shannon saw one at Greensburg November 21, 1896.

33. GENUS ARDETTA GRAY.

*a*¹. Size very small; sexes unlike; young unlike adult.

*b*¹. Wing under 9.50; color above, male glossy black, female brown; under parts buffy. **A. exilis** (Gmel.). 64

*64. (191). **Ardetta exilis** (Gmel.).

Least Bittern.

Male.—With the slightest crested crown; back and tail, glossy greenish-black; neck behind, most of the wing coverts and outer edges of inner quills, rich chestnut; other wing coverts, brownish-yellow varied with white along the throat line, the sides of the breast with a blackish-brown patch; bill and lores, mostly pale yellow, the bill blackish; eyes and soles, yellow; legs, greenish-yellow. *Female*.—With the black of the back entirely, that of the crown mostly or wholly, replaced by rich purplish-chestnut, the edges of the scapulars forming a brownish-white stripe on either side.

Length, 12.00-14.25; wing, 4.30-5.25; bill, 1.60-1.90; tarsus, 1.50-1.75.

RANGE.—America, north to British Provinces. York Factory, Manitoba, Ontario. Winters from southern Florida southward. Breeds throughout its range.

Nest, among reeds and swamp vegetation, of rushes. *Eggs*, 3-5; white, often greenish; 1.20 by .93.

Regular migrant; generally rare, but locally somewhat common; summer resident in suitable localities; some places common.

In the southern half of the State, outside of the immediate valley of the Wabash, it does not breed and is very rare. Two specimens were taken at Brookville years ago (Dr. Haymond). Besides these the only records for that part of the State are a specimen taken by Mr. E. L. Guthrie at Adams, Decatur County, in May, 1884, and one reported by Edw. Hughes, from the same place, May 15, 1890.

As migrants they are noted the latter part of April, in May and in September and October. The earliest record for the State is from Wabash County, where it was taken April 19, 1894. (Ulrey and Wallace, P. I. A. S., 1895, p. 150.)

Perhaps they begin their return migration in August, but I have no dates before early September. They were found at Hyde Lake

September 10, 1892 (Parker); at Sandusky, O., September 28, 1896 (Mosely), and Mr. Chas. Dury informs me of their occurrence at English Lake in October. There are specimens of this bird in the State Museum taken in Boone County. Mr. Ruthven Deane found a number at English Lake August 8, 1897.

"Breeds abundantly about Hyde Lake and Calumet, Ill., and at Wolf Lake, at Kouts and Liverpool, Ind., laying three or four greenish-white eggs in a nest just above the water" (Parker). Has also been reported breeding in Lake County by Mr. George L. Toppan, Mr. H. K. Coale and Mr. L. T. Meyer. Mr. C. E. Aiken, Starke County, English Lake, "saw several and found nest built of loose, dry cane, attached to the reeds three feet above water," June 10, 1888 (Deane); same locality (Dury); Dekalb County (McBride, Mrs. Janc L. Hine, Feagler); Vigo County, "a number breeding May 31, 1890" (Evermann); Boone County (Beasley); Laporte (Barber).

The account of his observations concerning their habits at breeding time has been very kindly furnished me by Prof. Evermann. He says: "I first discovered the nests of this bird May 31, 1890, while gathering water lilies in the pond (Goose Pond, nine miles south of Terre Haute). The water does not, in spring at least, reach a greater depth than three feet in its deeper parts. The center of the pond is filled with water lilies (*Nuphar* and *Nymphaea*), which were then in bloom, while in the more shallow water are rank growths of cat-tails, rushes (*Equisetum limosum*), sedges (*Sagittaria*), pickerel weed (*Peltandra undulata*), etc. We found on this day twelve nests, containing altogether forty-three eggs of the Least Bittern. A week later, June 6, I found two more nests, containing four and five eggs, respectively. I usually found the nest from a few inches to a foot above the water, placed upon a few stems or leaves of the cat-tail, which the bird had evidently bent down and arranged into a very shallow, insecure nest. In a few cases the nests were made of the leaves of *Sagittaria* or *Peltandra*, pressed down as were those of the cat-tail. I did not see the bird on the nest in a single case, so watchful and shy are they. In most cases, however, the bird would rise from the cat-tails and fly away, and I was usually able to find a nest not far from where it arose. I did not find more than five eggs in any set (1-5, 1-5, 1-4, 1-4, 1-4, 1-4, 1-1, 1-1, 1-3 and 1-3 May 31, and 1-4, 1-5 June 6), while most sets contained but four. All the eggs taken May 31 were fresh, and no doubt many of these sets containing but four eggs were not complete." Mr. Blatchley also obtained some eggs from the same pond.

It also nests on the ground, and is said sometimes to build in a bush. (Cook, B. of Mich., p. 50.) We are also assured in the same pub-

cation that they build false nests and that the male assists in incubating. They rear two broods a year, Dr. Langdon thinks, as he found incomplete sets early in July near Sandusky, O. (J. C. S. N. H., III, 1880, p. 227.)

Cory's Bittern, *Botaurus neoxena* Cory, has been taken in Ontario and Michigan, and should be sought in Indiana. Its habits are similar to those of this species and it frequents similar places. The following is its description:

Top of the head, back and tail, dark greenish-black, showing a green gloss when held to the light; sides of the head and throat rufous-chestnut; the feathers on the back of the neck showing greenish-black tips; breast and under parts, nearly uniform rufous-chestnut, shading into dull black on the side; wing coverts, dark rufous-chestnut; underwing coverts, paler chestnut; all the remiges entirely slaty, plumbeous; under tail coverts, uniform dull black. Total length, 10.80; wing, 4.30; tarsus, 1.40; bill, 1.80.

RANGE.—Florida, Okeechobee region. In Florida it is called "Black Bittern" to distinguish it from the "Least Bittern," which is called "Brown Bittern."

SUBFAMILY ARDEINÆ. HERONS AND EGRETS.

34. GENUS ARDEA LINNÆUS.

*a*¹. Bill shorter than tarsus.

*b*¹. Tarsus less than twice the length of middle toe without claw.

*c*¹. Wing over 14.00.

*d*¹. Color chiefly bluish; wing over 17.00. Subgenus ARDEA.

*e*¹. Top of head (sometimes entire head) white.

A. wuerdemanni Baird. 65

*e*². Top of head, including occipital plumes, black.

A. herodias Linn. 66

*d*². Color white; wing less than 17.00. Subgenus HERODIAS Boie.

*c*². Wing under 11.00.

A. egretta Gmel. 67

*f*¹. Color entirely white; plumes of breeding season very long, curved backward, with loose webs. Subgenus GARZETTA Kaup.

A. candidissima Gmel. 68

*f*². Tips of primaries bluish; sometimes most of plumage bluish; plumes of breeding season slender, with compact webs. Subgenus FLORIDA Baird.

A. cærulea Linn. 70

*a*². Bill not shorter than tarsus.

*g*¹. Wing more than 8.00. Subgenus HYDRANASSA Baird.

A. tricolor ruficollis (Gosse). 69

*g*². Wing not more than 8.00. Subgenus BUTOROIDES Blyth.

A. virescens Linn. 71

Subgenus ARDEA.

65. (—). *Ardea wuerdemanni* BAIRD.**Wurdemann's Heron.**

Adult.—Head, entirely white, forehead, streaked with blackish; nearly uniform bluish-gray above; lower parts, white, narrowly striped or streaked with black; thighs and edge of wing, cinnamon-rufous. *Young*.—Forehead and crown, dull slate color, narrowly streaked with white; feathers of occiput, white, with dusky tips; wing coverts, spotted with rusty, the lower and more posterior with large wedge-shaped white spots. (Ridgway.)

Length, 48.00-50.00; wing, 20.00-21.00; bill, 5.95-6.50; tarsus, 7.95-8.25.

RANGE.—Florida; accidental in southern Illinois and Indiana.

Nest, of sticks in trees. *Eggs*, about 2.60 by 1.84.

Accidental visitor. Mr. Ridgway reports positively identifying this species in Knox and Gibson counties in 1876. I know of no other account of its occurrence in the State. This is doubtless the same specimen to which he refers as having been seen on several occasions from September 4 to 22, inclusive, at Grand Rapids, in the Wabash River near Mt. Carmel, Ill. (Birds of Illinois, II, p. 121.)

This species is now included in the "hypothetical list" by the American Ornithologists' Union. Its relationship is not definitely known, but it is believed to be either the colored phase of *A. occidentalis* Aud. or an abnormal specimen of *A. wardi* Ridgw. (A. O. U. check list 1895, p. 328.) Until its status is determined it should retain its position in our list.

66. (194). *Ardea herodias* LINN.*Great Blue Heron.**

Synonym, BLUE CRANE.

Sexes similar. Female much smaller than male. Adult of both sexes grayish-blue above, the neck pale purplish-brown, with a white throat line; the head black, with a white frontal patch; the underparts mostly black, streaked with white; tibia, edge of wing and some of the lower neck feathers, orange-brown; bill and eyes, yellow; bill, dusky; lores and legs, greenish. The young differ considerably, but are never white, and can not be confounded with any of the succeeding species.

Length, about 42.00-50.00; wing, 17.90-19.85; bill, 4.30-6.25; tarsus, 6.00-8.00.

RANGE.—America, from Colombia Valley and Venezuela north to Hudson Bay and Sitka. Breeds locally throughout its range. Winters from southern Indiana and southern Illinois south.



Great Blue Heron.

Nest, of sticks, in trees. *Eggs*, 3-6; greenish-blue; 2.50 by 1.50.

Common migrant and summer resident; rare winter resident southward. Breeding abundantly in suitable localities in the northern half of the State and in Knox and Gibson counties. (Ridgway, Chansler.) It may breed at other points in the Wabash Valley. I cannot learn of its breeding along the Whitewater, but it has been re-

ported as breeding on the "Great Miami." (Langdon, revised list, Journ. Cin. Soc. Nat. Hist., January, 1879, p. 183.) They usually breed in communities of greater or less size, known as "heronries," but are occasionally found erecting solitary nests. Mr. C. E. Aiken, well known for his observations on the birds of Colorado, as well as of this State and Illinois, has very kindly written me his experience at a heronry known as "Crane Heaven," occupying thirty or forty acres along the Kankakee River some twenty miles above Water Valley. He was there in May, 1886. "The locality is a timbered belt, the ground being submerged with twelve to eighteen inches of water at the time. At our approach, upon the discharge of a gun, the birds arose with a noise like thunder and hovered in hundreds above the tree tops. They were of three species—the Great Blue Herons (*A. herodias*) and the Black-crowned Night Herons (*N. nycticorax naevius*) comprising the majority; but the beautiful white plumage of the American Egret (*A. egretta*) was conspicuous through the feathered cloud, and these birds were quite numerous.

"Nearly all the trees throughout the area were loaded with nests, those of the two species first named being found upon the same tree, but the latter birds appeared to build in little groups by themselves. We did not climb to examine the nests, but most of them appeared to contain young birds. Many of the trees were dead, apparently from the effects of the birds building and roosting upon them."

Mr. T. H. Ball informs me of two heronries in Lake County, one, called "Cranetown," in the southeastern corner of the county, and another in sections 5 and 6, north of the Brown Ditch—township 32, range 7, west.

Mr. Ruthven Deane has given me some observations on a heronry called "Crane Heaven" near English Lake, which, March 18, 1894, was occupied almost exclusively by Great Blue Herons, though quite a number of Black-crowned Night Herons always breed there.

Mr. J. G. Parker, Jr., informs me of a large colony on the Kankakee River nine miles south of Kouts, Ind. On April 14, 1894, he reports the heronry filled with birds nesting.

Mr. R. B. Trouslet, April 25, 1887, wrote me of a visit recently made by him from Valparaiso to "Cranetown," in Jasper County. There were, he said, thousands of Great Blue Herons nesting, and he saw one American Egret.

Mr. Chas. Dury also speaks of their building at English Lake.

Mr. L. T. Meyer, in 1886, wrote me of their building in the Kankakee Marsh in great numbers, nesting in communities.

It is reported breeding in Steuben County by Mr. J. O. Snyder, and at Golden Lake, that county, by Mr. J. P. Feagler and Mr. H. W. McBride. Mr. McBride says that this heronry is known as "Crane-town." The place is an almost inaccessible bayou, covered for the most part by very large elm trees. In these trees every year breed great numbers of Great Blue Herons.

Prof. B. W. Evermann records two large heronries and one small one in Carroll County. He found as many as thirteen nests on one tree, and many other trees contained from three to ten nests each. (The Auk, October, 1888, p. 347.)

Mr. E. R. Quick says there was a heronry about ten miles south of Frankfort, in Clinton County.

They have also been reported to have bred in the following counties: Vigo (Evermann), Allen (Stockridge), Dekalb (McBride, Mrs. Hine), Clinton (Ghere), Tippecanoe, at mouth of Tippecanoe River (Dr. E. Test). Almost all of these friends have testified to the effects of many destructive influences resulting from man's efforts to reclaim the land for tillage or from wantonness in times when he gave himself to sport or recreation. Swamps have been drained, trees felled, fire ravaged the heronries, the birds have been shot or driven away and the eggs permitted to spoil or the young perish. A number of colonies have been exterminated. All are year by year growing less. The people who live near the remaining heronies should protect the birds that are left. They do them no ill, but only good.

After the birds are reared they, to a greater or less extent, wander about the State. They arrive so early and nest so soon after arrival that when they appear many think they are late migrants or possibly summer residents. In the southern part of the State they occasionally pass the winter. The earliest migrant was noted by Prof. Evermann in Carroll County, February 14, 1885; Dekalb County, February 22, 1890 (H. W. McBride); March 11, 1894, Mr. Deane found one in "Crane Heaven," English Lake. This is the earliest date at a heronry. They usually appear at the heronries in March, the bulk arriving before April 15. Throughout the State they are found straggling along through April and occasionally until late in May; Richmond May 21, 1897 (Hadley). These stragglers must breed much later than the others, if at all. Mr. R. B. Trouslot reports taking two sets of eggs before April 25, 1887, and Mr. Deane reports young in some of the nests at English Lake, May 4, 1890.

They begin their fall migrations in August and continue passing through September and October, a few remaining sometimes late into November. I observed them at Brookville August 30 (1887). Mr.

Deane reported two at English Lake November 16, 1892. Mr. E. J. Chansler found it in Knox County December 9, 1896. They feed largely on fish and frogs.

SUBGENUS HERODIAS BOIR.

*67. (196). *Ardea egretta* GMEL.

American Egret.

SYNONYMS, GREAT WHITE HERON, WHITE CRANE.

Plumage entirely white, in breeding season, with long plumes projecting from the back and drooping beyond the tail; bill, lores and eyes, yellow; legs and feet, black.

Length, 37.00-41.00; wing, 14.10-16.80; bill, 4.20-4.90; tarsus, 5.50-6.80.

RANGE.—Temperate and tropical America, from New Jersey, Minnesota and Oregon south to Patagonia; casually on the Atlantic Coast to Nova Scotia. Breeds northward to northern Indiana.

Nest, in trees or bushes over water, of sticks. *Eggs*, 3-5; dull blue; 2.28 by 1.60. Usually breeds in colonies.

Regular migrant and summer resident, formerly tolerably common, becoming rare. Breeds in some numbers locally in the northern part of the State and in the lower Wabash Valley in situations similar to those occupied by the last mentioned species, and generally associated in the same colony with them. For many years they have been known to breed in Knox and Gibson counties, and the fact that throughout the summer they were found over the State seemed to indicate that they must certainly have a breeding ground somewhere farther north than any yet reported. Their occurrence has been explained upon the theory that some birds, particularly herons, were given to wandering northward after the breeding season, and most of the vagrants were young birds. Further, this heron was practically unknown within the State in early spring before the herons nesting time. Now we know that it still breeds in some, and did very recently in all, of at least six or eight of the counties in northern Indiana; also, that it is very rarely, indeed, observed in its northward migrations before breeding time. This indicates these herons migrate at night. They are usually seen at the breeding grounds, nesting or preparing to, before they are reported by the observers throughout the State. Apparently they proceed directly to the heronries, and the few seen later are stragglers, who would arrive too late to take part in the important work of nesting at the northern colonies.

Mr. E. J. Chansler has informed me of their breeding at Swan and Grassy Ponds, Daviess County. The summer of 1897 he visited these ponds and learned that Egrets had been very scarce that year. On Swan Pond, where formerly a thousand could be seen in one flock, none were found. Daviess County adjoins Knox and Gibson, where Mr. Ridgway has reported them nesting. Mrs. Jane L. Hine and Mr. H. W. McBride have reported them nesting in Dekalb County. Mr. McBride says at the heronry at Golden Lake, Steuben County, for several years, he often saw a pair of these birds among the many Great Blue Herons, and while satisfied they nested, he could not determine which nest was theirs. A hunter well known to Mr. McBride informed him of shooting a "White Crane," which he described, from its nest at Wolf Lake, Noble County. This must have been the present species.

Mr. R. B. Trouslot, on the occasion of his visit to "Cranetown," Jasper County, in April, 1887, among the thousands of Great Blue Herons breeding, found a few American Egrets, but did not identify their nests. As is noted under the last species, Mr. C. E. Aiken found them breeding quite numerously with that species at "Crane Heaven," on the Kankakee River some twenty miles above Water Valley. Mr. F. M. Woodruff and Mr. J. G. Parker, Jr., both of Chicago, have kindly furnished me with separate accounts of the breeding of the American Egret in Porter County at different dates, but whether the locality referred to is the same, I do not know. Mr. Woodruff says Mr. Chas. Eldridge found this bird breeding at Kouts, Ind., in May, 1885, and took a large number of their eggs. He found their nests in the same trees with those of the Great Blue Heron. He adds: "I visited the heronries last June (1896), and did not see a single specimen of the White Egret. In the fall of 1895 a terrible fire swept through the timber along the Kankakee River, which probably accounts for the depopulated state of the heronries."

Mr. Parker informs me that Mr. George Wilcox found quite a number breeding in a heronry with the last species near Kouts, Ind., during May, 1895. Mr. Parker himself visited the place in the spring of 1896, and found only a few *A. herodias* occupying the heronry. He thinks the small number of those found was due to the fact that a heavy fire swept through the timber in the fall of 1895. The same gentleman observed a flock of about twenty-five at Liverpool August 27, 1887. By this time most of them have gone through. There are a few references to its rare occurrence later. Prof. Evermann has noted it in Carroll County in early September. Mr. Deane has seen it at English Lake in September, and Dr. Langdon notes it, upon the authority of Mr. Porter, near Sandusky, O., in that month. In Florida,

where these birds were found a quarter of a century ago in an innumerable company, arrayed in dazzling white where lagoons were bordered by their snowy forms, and the bushy breeding grounds covering a wide area, glistened in the sun, they have, at fashion's bidding, been offered upon the altar, and countless as their numbers seemed to be, they have in a very few short years been almost exterminated for the adornment of the women of our own and other lands. An excellent article on this subject is given by W. E. D. Scott in the *Auk*, 1887, p. 135.

They pass the winter farther south than the Great Blue Heron and are a little later in beginning their migrations in the spring. Yet I feel satisfied that they migrate much earlier than we have been accustomed to think. Mr. Nelson mentions its occurrence at Evanston Ill., March 31, 1895. (*Birds of Northeastern Illinois*, p. 131.) The earliest record for Indiana is that given by Prof. Evermann from Bloomington, April 10, 1887. I have records for that month from Putnam and Decatur counties, outside of the region where they breed. A few straggle along through May.

One was found as far away from the swamps where they breed as Decatur County, June 23, 1894. The latter part of July they begin to wander about the country in numbers, sometimes singly, but often in small flocks of two to a dozen, and occasionally in larger bodies of twenty-five to thirty individuals, gradually making their way southward. A summer when there has been ample rainfall and the leaves of the fringing trees along the rivers are dense and dark green, the sight of a large flock of these snow-white birds flying through them or alighted among their foliage is one that ever clings to me as a memory of such an August. I have never seen them at Brookville earlier than July 27 (1887) or later than August 11 (1886). There is no record of their occurrence in the Whitewater Valley in spring. Mr. F. M. Woodruff, in speaking of a trip into Lake County, August 18, 1885, says: "As we passed through the long stretch of swamp woods lying between Whiting and Clark stations we observed large flocks of the American Egret on almost all of the ponds of any size along the line of the road. They did not appear to be frightened by the train, and only those within forty or fifty yards of the train would fly. At Liverpool we found the birds on the Little Calumet River in small flocks of two to six or eight."

SUBGENUS GARZETTA KAUF.

68. (197). *Ardea candidissima* (GMEL.).*Snowy Heron.**

Adult.—In breeding season “with a long occipital crest of decomposed feathers and similar dorsal plumes, latter *recurved* when perfect; similar, but not recurved plumes on the lower neck, which is bare behind; lores, eyes and toes, yellow; bill and legs, black, former yellow at base, latter yellow at lower part behind; plumage always entirely white.” (McIlwraith, Birds of Ontario.) Smaller than the last. Adult, after breeding season, and immature without dorsal plumes.

Length, 24.00; wing, 11.00-12.00; bill, 3.00; tarsus, 3.50-4.00.

RANGE.—Temperate and tropical America, from Long Island and Oregon south to Argentine Republic and Chili; casually to Nova Scotia and southern British Columbia. Minnesota. Breeds north to southern Indiana.

Nest, in trees and bushes, of sticks. *Eggs*, 3-5; pale, dull blue; 1.82 by 1.22.

Migrant and summer resident in southern part of the State; not common; breeding locally in the lower Wabash Valley. Mr. Ridgway informs me of its breeding in Knox and Gibson counties. Mr. E. J. Chansler tells me of its occurrence at Swan and Grassy ponds, Daviess County, where he thinks it breeds. Prof. J. A. Balmer says though they varied in numbers from year to year, they were quite constant summer residents in Knox County in 1890. They were common about Swan Pond. This, so far as known, is its most northern breeding ground. After breeding they roam over the country, some extending their journeys, as may be gathered from reported occurrences, into Michigan, Ontario and Manitoba. They are smaller birds than the last species, but are exceedingly graceful. Their range is not so extensive and their numbers are less with us. They have been noted in Lake County (L. T. Meyer), Allen County (C. A. Stockbridge), Franklin County (E. R. Quick), Jefferson County (Hubbard), and lower Wabash Valley (Stein). Some of these records may refer to the larger species last mentioned.

Like the American Egret, the Snowy Heron is guilty of wearing through the breeding season beautiful plumes. These are the ornaments technically called “aigrettes” by the millinery trade. To secure them the death of the bird is necessary. This necessity has led to the destruction of the larger part of the great numbers of these beautiful, graceful birds, which were so characteristic an aspect of the southern landscape a few years ago. These birds were not injurious; they were

the friend of man. They were sacrificed for the necessity of fashion. "Necessity knows no law." To ornament the devotees of fashion for a brief season it was necessary to destroy one of the most graceful and characteristic ornaments of this beautiful land of ours.

SUBGENUS HYDRANASSA BAIRD.

69. (199). *Ardea tricolor ruficollis* (Gosse).

Louisiana Heron.

Adult.—Head, neck and upper parts bluish plumbeous; plumes of occiput and nape, rich maroon purplish and plumbeous-blue; chin and upper part of throat, pure white, continued in streaks, mixed with rufous and plumbeous down the foreneck; scapular plumes, light drab; lower parts, plain white. *Immature*.—Head and neck, chiefly light rusty; the malar region, chin and throat, pure white; foreneck streaked white and rusty; lower parts, rump and upper tail coverts, pure white; upper parts (except rump, etc.), plumbeous, the back tinged and the wing coverts spotted with rusty; legs, yellowish behind, blackish before; lower mandible and lores, orange; upper mandible, black.

Length, 23.00-28.00; wing, 8.35-10.80; bill, 3.30-4.15; tarsus, 3.20-4.15.

RANGE.—Gulf States, Mexico (both coasts), Central America and West Indies; casually northward to New Jersey and Indiana.

Nest, similar to that of Snowy Heron. *Eggs*, 2-4, sometimes 5; bluish-green; 1.75-1.80 by 1.30-1.40.

Rare summer visitor. Mr. F. T. Jencks identified it near Hannah, Starke County, in June, 1876. (Bull. Nuttall Orn. Club, April, 1877, p. 51.) Mr. E. J. Chansler reports having seen it in Knox County the summer of 1894.

This is a bird of the coast of the Gulf of Mexico. No other records are reported of its occurrence so far inland.

SUBGENUS FLORIDA BAIRD.

*70. (200). *Ardea cærulea* LINN.

Little Blue Heron.

Adult.—Usually uniform dark slate blue, with maroon-colored head and neck, but not infrequently "pied," with white, or even almost wholly white, with bluish tips to longer quills. *Young*.—Usually pure white, with longer quills tipped with slate blue; legs, feet and lores, greenish-yellow.

Length, 20.00-29.50; wing, 9.00-10.60; bill, 2.70-3.30; tarsus, 3.15-4.00.

RANGE.—America, from Colombia and Guiana north to New Jersey, Indiana and Kansas; casually on Atlantic Coast to Maine. Breeds north to southern Indiana.

Nest, in trees or bushes. **Eggs**, 2-4; bluish-green; 1.60-1.82 by 1.25-1.35.

Summer resident in the lower Wabash Valley. There it was first noted by Dr. F. Stein, perhaps in 1874. Mr. Robert Ridgway then noted it in Knox and Gibson counties, where it breeds. He informed me about eight years ago it was found abundantly along that part of the Wabash River every summer. Mr. E. J. Chansler has more recently informed me of its breeding. In 1896 he noted it as early as April 18, and the latest fall record I have is September 24, 1895.

SURGENUS BUTORIDES BLYTH.

***71. (201). *Ardea virescens* LINN.**

Green Heron.

Adult.—In breeding season, with the crown, long, soft occipital crest and lengthened narrow feathers of the back, lustrous dark green, sometimes with a bronzy iridescence, and on the back often with a glaucous cast; wing coverts, green, with conspicuous tawny edgings; neck, purplish-chestnut, the throat line variegated with dusky or whitish; under parts, mostly dark brownish-ash; belly, variegated with white; quills and tail, greenish-dusky, with a glaucous shade; edge of the wing, white, some of the quills usually white tipped; bill, greenish-black, much of the under mandible yellow; lores and iris, yellow; legs, greenish-yellow; lower neck, with lengthened feathers in front, a bare space behind. **Young.**—With the head less crested, the back without long plumes, but glossy-greenish; neck, merely reddish-brown and whole under parts white, variegated with tawny and dark brown.

Length, 15.50-22.50; wing, 6.30-8.00; bill, 2.00-2.55; tarsus, 1.75-2.15.

RANGE.—America, from Colombia, Venezuela and West Indies north to Ontario, Manitoba and Oregon. Breeds north to limit of its range. Winters from Florida southward.

Nest, of sticks, in small tree or bush, sometimes in orchard. **Eggs**, 3-6; pale greenish-blue; 1.50 by 1.14.

Summer resident throughout the State. This small heron is found wherever there is water, about streams, ponds and lakes. It usually

makes its nest not far from water, often in orchards. These birds are commonly known as "Schytepoke," "Poke" and "Fly-up-the-creek."

It usually appears in the southern part of the State between April 10 and May 1, and in the northern part from April 18 to May 5. I have noted it at Brookville as early as April 12 (1881), and Prof. Blatchley reported it from Terre Haute April 13 (1888). The following dates of its first appearance at Brookville for a number of years, excepting the one above noted, will give an idea of its variations year after year: 1882, April 18; 1883, April 13; 1884, April 15; 1885, April 18; 1887, April 21; 1889, April 19; 1892, April 25; 1896, May 1.

They begin nesting immediately upon arriving, usually, selecting a thicket or second growth near the water. They often breed in orchards, frequently at some distance from water. They usually nest singly, but sometimes in colonies. (Ridgway.)

The nests are sometimes placed from eight to twenty feet above the ground. Prof. Evermann found full sets of eggs in Carroll County by May 15, and Mrs. Hine reports the bird sitting in Dekalb County May 15, 1897. Mr. H. N. McCoy caught young ready to fly near Richmond, May 19, 1886. After leaving the nest the family keeps together for some time; then they may be found along the streams and about the ponds and sloughs. Sometimes they are standing upon the shore; at others upon a drift pile; again upon a log or pole above the water, but more frequently, perhaps, upon a tree or bush, from which the approach of the intruder will frighten them to an awkward flight, which is usually preceded or accompanied by a startled squawk. In some localities they are becoming less common than formerly, but still it is the most common and best known heron in the State. In the northern part of the State they are leaving late in August, and by early September seem to have left. Steuben County, Aug. 15, 1894 (Cass); Tippecanoe County, September 4, 1896; Warren County, September 22, 1897 (Barnett). In the southern portion of the State they remain later some years, but not often far into October. Brookville, October 11, 1886; October 1, 1889. Greensburg, October 17, 1894 (Shannon), is the latest fall record.

35. GENUS NYCTICORAX STEPHENS.

α^1 . Bill about as long as tarsus; gonys nearly straight. Subgenus NYCTICORAX.

N. nycticorax naevius (Bodd.). 72

α^2 . Bill much shorter than tarsus; gonys convex.

Subgenus NYCTINASSA Stejneger. **N. violaceus** (Linn.). 73

Subgenus NYCTICORAX.

***72. (202). Nycticorax nycticorax naevius (Bodd.).**

Black-crowned Night Heron.

Synonyms, QUAWK, SQUAWK, QUA-BIRD.

Adult.—Crown, scapulars and interscapulars, very dark glossy-green; general plumage, bluish-gray, more or less tinged with lilac; forehead, throat line and most under parts, whitish; two or three occipital plumes about 8.00 long, white; bill, black; lores, greenish; eyes, red; feet, yellow. *Young*.—Very different, lacking the plumes; grayish-brown; paler below, extensively speckled with white; quills, chocolate-brown, white-tipped.

Length, about 23.00-26.00; wing, 11.00-12.80; bill, 2.80-3.10; tarsus, 3.10-3.40.

RANGE.—America, Falkland Islands and Chili north to Manitoba and Ontario. Breeds north to limit of its range. Winters from Gulf States south.

Nest, of sticks, usually in trees; sometimes in colonies. *Eggs*, 4-6; pale greenish-blue; 2.01 by 1.47.

Regular migrant and summer resident. Breeds locally in northern part of the State in some numbers, in colonies, by themselves or with other herons.

They arrive in the spring about the time of the last species. The earliest date I have comes from its breeding ground, Liverpool, Ind., April 10, 1897 (Parker). This indicates that some, at least, proceed straight to their heronries and others follow along more leisurely. The following dates give the time of its first appearance in Indiana for a number of years: Carroll County, April 30, 1878 (Evermann); Brookville, April 28, 1883; Marion County, April 18, 1884 (Noe); Brookville, May 6, 1885; English Lake, May 6, 1888 (Deane); Dekalb County, April 29, 1893 (Mrs. Hine); Greensburg, April 14, 1894 (Shannon).

The migration is over early in May, and by the latter part of that month nests can be found, although some of them continue building well into June. There is a heronry where they breed at English Lake. (Deane.) Two nests were found there May 25 and 26, 1889, and June

10, 1888, there were large numbers in the heronry. Many were flying over, carrying sticks and building.

The heronry "Crane Heaven" mentioned under Great Blue Heron, upon authority of Mr. C. E. Aiken, some twenty miles above Water Valley on the Kankakee, contained, in 1886, great numbers of this species. They were nesting upon the same trees with *A. herodias*. Mr. J. G. Parker, Jr., informs me that a large colony breeds every year in Sandy Hook Marsh, on the Kankakee River, two miles south of Kouts. The young, fully fledged, are taken through June and July. Ordinarily they depart in September and early October. Occasionally, however, a few are found well into November. These late birds generally are young. Prof. B. W. Evermann took a young female in Carroll County November 24, 1884. This is the latest record I have. Mr. A. W. Hamilton took a young bird at Zanesville, Wells County, November 12, 1896. Mr. Ruthven Deane reports two specimens at English Lake November 16, 1892.

They are usually nocturnal in their habits, but sometimes, especially after the young are hatched, they may be seen hunting food by day, as well as by night. The common name given to it by those who live near its colonies, on account of its note, is "Quawk."

Subgenus NYCTINASSA STEJNEGER.

*73. (203). *Nycticorax violaceus* (LINN.).

Yellow-crowned Night Heron.

Synonym, WHITE-CROWNED NIGHT HERON.

Adult.—Top of head and elongated patch on side of head, white, the first often stained with rusty brown, and in freshly killed or living specimens deeply tinted with delicate primrose-yellow; rest of head, black; plumage in general, bluish-plumbeous, plain beneath, but on upper parts striped with black. *Immature*.—Top of head, black; above, sooty grayish-brown, streaked with dull white or pale buff, the streaks more wedge-shaped on wing coverts; lower parts, soiled whitish, striped with brownish-gray.

Length, 22.00-28.00; wing, 10.50-12.65; bill, 2.50-3.00, tarsus, 3.10-4.20.

RANGE.—America, from Brazil north to South Carolina, southern Indiana, lower California, casually to Massachusetts and Colorado. Breeds from southern Indiana southward.

Nest, of sticks, in trees. *Eggs*, 4-5; pale, bluish-green; 1.96 by 1.42.

Common summer resident in some localities in the lower Wabash Valley. Breeds in colonies.

Mr. Robert Ridgway says: "At Monteur's Pond, about eight miles east of Vincennes, Ind., it is the most numerous species of Heron, far outnumbering all other kinds together, during several visits there in different years." (Birds of Ill., Vol. II, p. 136.) In an account of a visit to the locality above mentioned in the spring of 1881, the same writer noted "a colony of perhaps a hundred pairs having their nests among the tall ash and sweet-gum trees, in a creek bottom, near the edge of the pond." The nests are mostly at a considerable height, and few of them are readily accessible. They were just beginning to lay, and were frightened away from the locality during a 'wet spell' by squirrel hunters. A female was shot from her nest April 27, and a perfect egg cut from her oviduct. Several fine specimens of the bird were secured, and it was noticed that the delicate, almost luminous, yellow buff on the forehead soon faded." (Bull. Nuttall Orn. Club, Jan., 1882, p. 22.)

"In an adult female shot from her nest at Wheatland, Ind., April 27, 1881, the bill and naked lores were wholly slate-black, the eyelids similar, but tinged with green anteriorly; iris, mars-orange; legs, pale olive-buff; the large scutellæ of tarsus, and toes deep brownish." In the adult male in spring, according to Audubon, the unfeathered parts are colored as follows: "Bill, black; iris, reddish-orange; margins of eyelids and bare space in front of the eye, dull yellowish-green; tibia, upper part of the tarsus, its hind part, and the soles, bright yellow; the scutellæ and scales, the fore part of the tarsus, the toes, and the claws, black." (Ridgway, Birds of Ill., Vol. II, p. 136.)

This species is perhaps a little later migrating than that last mentioned. The colony noted is the most northern known of this Heron. It, too, goes by the same name in some localities as the other Night Heron, "Squawk." They are said usually to build in pairs, and to be less nocturnal than the other species.

F. ORDER PALUDICOLÆ. CRANES, RAILS, ETC.

SUBORDER GRUES. CRANES.

XV. FAMILY GRUIDÆ. CRANES.

Characters same as family.

GRUS. 36

36. GENUS GRUS PALLAS.

 α^1 . Tarsus 11.00 or over.*G. americana* (Linn.). 74 α^2 . Tarsus 10.00 or less.*G. mexicana* (Müll.). 7574. (204). *Grus americana*. (LINN.).

Whooping Crane.

Adult.—Plumage, white; the primaries, black; upper part of head and cheeks, and sides of throat, naked, red. *Immature*.—Plumage, white, more or less washed with light cinnamon; head, feathered.

Length, 50.00-54.00; extent, 92.00; wing, 22.00-25.00; bill, 5.35-5.80; depth of bill at base, 1.40; tarsus, 11.00-12.00.

RANGE.—Interior of North America, Florida and Central Mexico, north to fur countries, and from Ohio to California; formerly on Atlantic coast, north to Massachusetts. Breeds from Illinois north; also on Gulf coast (McIlhenny). Winters in Gulf States.

Nest, in marshes, of grasses. *Eggs*, 2; olive or olive-buffy, marked with brown and grayish; 4.04 by 2.50.

Rare migrant; formerly more common. It has been known to breed in Central Illinois (Nelson), and Clear Lake, Iowa (Cooke), and doubtless did so in Indiana. Mr. L. T. Meyer says, in Lake County, it is exceedingly rare. It was a summer resident, but the draining of the Kankakee marshes has driven it away. Mr. Timothy H. Ball writes me of their former occurrence in Lake County, also. He says they were common, but not as abundant as the Sand Hill Crane. He thinks they nested in the big Kankakee marsh. They were beautiful objects as they stood out upon the prairie, the black on their wings contrasting so plainly with their white plumage. They did not come into the cornfields as the Sandhills did, but standing in the water they seemed from a distance like them, only they were white. Mr. Charles Dury, of Cincinnati, O., informs me of its occurrence in "North Indiana;" also that there is a specimen in the Cuvier Club in that city that was taken near Bloomington, Ind. Dr. A. W. Brayton notes that it was formerly abundant.

75. (206). *Grus mexicana* (MÜLL).*Sandhill Crane.**

Adult.—With the bare part of head forking behind to receive a pointed extension of the occipital feathers, not reaching on the sides below the eyes, and sparsely hairy; bill, moderately stout, with nearly straight and scarcely ascending gonys, that part of the under mandible not so deep as the upper at the same place; adult plumage, plumbeous gray, never whitening; primaries, and their coverts, blackish. *Immature*.—With head feathered and plumage varied with rusty brown; rather smaller than the last.

Length, 40.00-48.00; wing, 21.00-22.50 (21.83); bill, 5.15-6.00 (5.47); depth of bill at base, .95-1.10 (1.01); tarsus, 9.90-10.65 (10.25); middle toe, 3.40-3.60 (3.50); bare part of tarsus, 4.60-5.00 (4.78).

RANGE.—North America, north to Ontario, Michigan and Manitoba. Most abundant from Mississippi Valley to Pacific coast. Casually to Hudson Bay. Rare on Atlantic coast north of Georgia. Breeds locally throughout its range. Winters in Gulf States and Mexico.

Nest, on ground in grassy ponds and marshes, of grass, reeds, etc. *Eggs*, 2; olive-brown or drab, spotted with brown and gray; 3.98 by 2.44.

Regular migrant; sometimes common. Occasional summer visitor. Occasional summer resident in northwestern Indiana. Formerly breeding abundantly in the large marshes of the State (Brayton). It is most commonly found in the Wabash Valley and northward; elsewhere very rare. It has been noted but once in the Whitewater Valley—Dr. Rufus Haymond saw three specimens.

Many people confound this bird with the Great Blue Heron, which is popularly known by the erroneous name "Blue Crane."

The Herons are distinctly fishers and frequent the waterways, while the Sandhill Crane frequents pastures, fields, dryer marshes, and prairies, and subsists upon field mice, grasshoppers, and other insects, and vegetable food, notably potatoes and sweet potatoes, of which they are very fond.

They pass north in the spring, in March and early April. The earliest arrival I have is March 7, 1894, when Mr. Deane noted a flock at English Lake. The earliest spring record for the southern part of the State is Bicknell, Knox County, March 21, 1895 (Chansler). Mr. S. T. Sterling reported it from Camden, Carroll County, April 13, 1888.

Mr. Ruthven Deane tells me that at English Lake March 25, 1892, he could hear them all day uttering their hoarse, guttural rattle, while soaring so high one could not see them, as the atmosphere was a little

hazy. At their breeding ground the first intimation of their presence is their "loud trumpeting or croaking, which seems to shake the air for miles" (Thompson). In the Wabash Valley old settlers recall the earlier days, when the birds were abundant, and tell with pleasure of the sight of them soaring grandly hundreds of yards above the earth.

They have been reported in recent years to breed in the following counties: Carroll (Sterling); Fulton (Dr. V. Gould); Lake (Ball); and Starke (Deane, Gault); and as migrants from Knox (Chandler), and Newton (Pfrimmer).

Soon after arrival they begin mating. Their actions at that season are admirably described by Colonel Goss. He says: "During courtship and the early breeding season their actions and antics at times are ludicrous in the extreme, bowing and leaping high in the air, hopping, skipping, and circling about, with drooping wings, and croaking whoop, an almost indescribable dance and din, in which the female (an exception to the rule) joins, all working themselves into a fever of excitement, only equaled by an Indian war dance, and, like the same, it only stops when the last one is exhausted."

Mr. B. T. Gault wrote me in 1892 that he was informed a pair or two still nested each season at Beaver Lake, Starke County, their nesting site being a marshy island in the lake. They were also said to perform their dances or "cotillions" in that region every spring. Mr. R. W. Stafford saw two eggs taken from a nest at North Judson, Starke County, May 5, 1890 (Deane). Mr. Joseph E. Gould, in a letter to Mr. Ruthven Deane, tells of finding young cranes east of Runnymede, in the same county, June 11, 1891. He says: "On emerging from the opposite side of a hummock of small poplars, I saw two Cranes feeding near a large oak that stood alone on a small elevation. Both birds flew, one going out of sight, while the other circled around and alighted a short distance off. I walked over to the tree and looked about in the grass, hoping to find their nest, but could see no sign of it. I then climbed up into the tree and sat perfectly still, and soon the old bird began to call and walk toward me. When within about one hundred yards of me she began to retrace her steps, and then I saw a little downy Crane following her. I jumped out of the tree and ran over, but the little fellow was too quick, and dodged me. I repeated the operation three times, but without success. I should say the young Crane was two or three weeks old. I was informed a farmer had captured a small Crane in that locality, which, I think, accounts for my only seeing one. I feel certain from the number of birds I saw that there are several pairs breeding on the north marsh."

Dr. H. M. Smith, of Knox County, once had a pet Sandhill Crane,

which he had wounded and captured. It became quite domesticated, and was much attached to him. When he would return from a ride in the practice of his profession, it would show its joy by standing on one leg, picking up chips with its bill and throwing them into the air, and many other antics (Chansler).

Mr. T. H. Ball, of Crown Point, speaking of a period of from fifty to sixty years ago, says: "Sandhill Cranes were found here in abundance. They came in early spring, and went south late in the fall. They nested in the Kankakee marsh region. In the fall they would come from the marshes into our cornfields, forty or fifty, perhaps a hundred, at a time, and tear the corn almost as bad as a drove of hogs. Then I shot them. They were fat, and considered, when properly cooked, superior to wild geese." He describes their dances as given upon a knoll on the prairies. Mr. Ball says a few remain, and still (1897) make nests south of Ridge Island, and south of the Brown ditch in Lake County.

They begin their movements southward in September, and continue them through November. Mr. Deane saw many at English Lake September 21, 1889. October 10, 1892, he says, they were quite abundant at the same place. Mr. Chansler notes them in Knox County October 27, 1894.

SUBORDER RALLI. RAILS, GALLINULES, COOTS, ETC.

XVI. FAMILY RALLIDÆ. RAILS, GALLINULES, ETC.

- a*¹. Forehead feathered. No frontal shield.
- b*¹. Bill slender, longer than head, curved downward. RALLUS. 37
- b*². Bill stout, not longer than head, straight. PORZANA. 38
- a*². Forehead covered by a broad, bare, horny shield.
- c*¹. Sides of toes with broad, lobed membranes. FULICA. 41
- c*². Sides of toes with narrow membranes or none.
- d*¹. Nostrils small, oval; middle toe (without claw), shorter than tarsus. IONORNIS. 39
- d*². Nostrils slit-like; middle toe (without claw), longer than tarsus. GALLINULA. 40

SUBFAMILY RALLINÆ. RAILS.

37. GENUS RALLUS LINNÆUS.

- a*¹. Wing over 5.00. *R. elegans* Aud. 76
- a*². Wing under 5.00. *R. virginianus* Linn. 77

*76. (208). *Rallus elegans* AUD.

King Rail.

Synonyms, RED-BREASTED RAIL, MARSH HEN.

Above, brownish-black, variegated with olive-brown, becoming rich chestnut on the wing coverts; under parts, rich rufous or cinnamon-

brown, usually paler on the middle of the belly, and whitening on the throat; flanks and axillars, blackish, white-barred.

Length, 17.00-19.00; wings, 5.90-6.80 (6.43); bill, 2.12-2.50 (2.35); least depth of bill, .27-.35 (.30); depth at base, .50-.55 (.52); tarsus, 2.10-2.40 (2.28).

RANGE.—Fresh-water marshes of the eastern United States, north to the middle States, southern Michigan, northern Illinois, Wisconsin and Kansas; casually to Massachusetts, Maine, and Ontario. Breeds throughout its range. Winters from Virginia southward.

Nest, of reeds and grass, in a marsh. *Eggs*, 6-15; buff or cream, speckled and blotched with reddish-brown.

Migrant; summer resident locally in the Wabash Valley and northward; rare some places, but common among the lakes and marshes in the northern part of the State, where they breed in some numbers. In the southern half of the State they are rare.

They arrive in the spring late in April and early in May, and those that do not remain to breed pass northward without much delay.

My earliest date is from Brookville, where one was taken on April 20, 1881. Sometimes in spring they are found in some numbers, as though traveling in small flocks. They go south from late August to the middle of October. They begin the duties of home building promptly upon arrival. Nests have been found with fresh eggs in June. Mr. Deane found a nest containing ten eggs quite fresh June 3, 1888. It was built on a small tussock at the base of a small bush in an overflowed meadow.

Mr. H. K. Coale says, the parents have been noted with downy, black young following, June 8 and 16, 1878; June 1, 1884. Mr. Ridgway tells me it breeds in Knox and Gibson counties. It evidently bred in Putnam County in 1894. Mr. Jesse Earlle found it at "Mill Pond," near Greencastle July 24, 25, 26, and 27, 1894. A young King Rail, not grown and not in full plumage, was brought to Mr. Alexander Black for identification. Mr. Deane says of a nest found by Mr. Steinman May 11, 1890: "It was built in an overflowed meadow, and consisted of broken, dried cane thrown up. The nest proper was very small, and contained twelve eggs piled upon top of each other." It is reported as breeding in the following counties: Lake (Aiken); Laporte (Barber), Dekalb (Feagler), and Mr. J. E. Beasley thinks it may breed in Boone County. This is the largest Rail in this State.

77. (212). *Rallus virginianus* (LINN.).*Virginia Rail.**

Coloration, exactly as in *elegans*, of which it is a perfect miniature.

Length, 8.12-10.50; wing, 3.90-4.25; bill, 1.45-1.60; tarsus, 1.30-1.40.

RANGE.—North America, from Guatemala and Cuba, north to British Columbia and Hudson Bay. Breeds from Pennsylvania and Indiana (Florida, Davie), northward. Winters from southern Illinois southward.

Nest, on ground, in marsh near water, of reeds and rushes. *Eggs*, 6-12; buff or cream; 1.24 by .94.

Rather common migrant, most numerous in spring; summer resident in some numbers locally, principally northward.

They begin to arrive from the south from April 20 to May 10, depending upon the lateness or earliness of the season, and there is but little difference between the time of their arrival near the Ohio River and at Lake Michigan. They migrate, as all Rails do, by night, and do not linger long by the way. The earliest spring records are: April 20, 1888, at Brookville, and April 20, 1897, Lake County (Parker). In Lake County they are not nearly so common as the Sora, but still are not rare about the lakes (Parker). In the same county Mr. C. E. Aiken noted it breeding, but not abundantly. In Dekalb County, Mr. J. O. Snyder says it breeds; while both are common, Sora is most common. In Steuben County it is abundant. Mr. C. L. Barber says it breeds in Laporte County. Mr. H. W. McBride found it breeding in Elkhart County, May 19, 1890.

At English Lake, Mr. Deane tells me, they are not common and are not found with the Soras. This habit of choosing a locality not frequented by the Soras is often noted. Mr. William S. Perry found them as common as the Sora in April, 1885, in the Kankakee marsh. (See Yellow Rail).

In the fall they go as they came—by night. While many start ahead, the bulk of them go at one time. One day the marshes are full of their noisy notes. A heavy frost comes and the reeds are deserted. The noticeable scarcity of Virginia Rails in the fall impresses all who have observed them. Their fall records are exceedingly few. They seem to all leave the first half of September. Mr. Deane, writing concerning English Lake, says: "We never get the Virginia Rail in the fall. I have examined a good many bags of small Rail in August and September, and have killed as many as eighty in a morning, and no Virginias taken." They frequent overflowed meadows and marshes,

and generally are not found where the water is deep. "The call of this species is rendered crick-cuk-rik-k-k-k" (E. E. Thompson). It was taken at Rock Lake, Fulton County, September 1, 1894 (Ulrey and Wallace); Hyde Park, Ill., September 19, 1893 (Parker); Borden, Ind., September 11, 1894 (E. S. Hallett); Greencastle, Ind., August 1, 1894 (A. Black, J. Earle).

38. GENUS PORZANA VIEILLLOT.

α^1 . Secondaries without white.

b^1 . Wing over 4.00; olive brown above, striped with black.

Subgenus PORZANA. *P. carolina* (Linn.). 78

b^2 . Wing under 3.50; dusky, usually speckled with white.

Subgenus CRETISCUS Cabanis. *P. jamaicensis* (Gmel.). 80

α^2 . Secondaries white. Subgenus COTURNICOPS Bonaparte.

P. noveboracensis (Gmel.). 79

Subgenus PORZANA.

*78. (214). *Porzana carolina* (Linn.).

Sora.

Adult.—With the face and central line of the throat, black; the rest of the throat, line over eye, and especially the breast, more or less intensely, slate-gray; the sides of the breast usually with some obsolete whitish barring and speckling. *Immature*.—Without the black, the throat whitish, the breast brown.



Sora.

Length, 7.85-9.75; wing, 4.15-4.30; bill, .75-.90; tarsus, 1.25-1.35.

RANGE.—Northern South America and West Indies, north to Manitoba, Hudson Bay, and casually to Greenland. Breeds from Louisiana (McIlhenny) northward. Winters from southern Illinois and South Carolina southward.

Nest, of grass and rushes, on ground in marshes. *Eggs*, 8-20; brownish buff, spotted with brown; 1.26 by .90.

Common migrant throughout the State; summer resident in the northern part, where it breeds commonly.

They appear as soon in the northern part of the State as they do in the southern. They usually arrive between April 15 and May 5, but Mr. Hadley noted them at Richmond April 11, 1897. The migration, however, continues past the middle of May. I have taken them at Brookville May 16, 1888. They are not paired when they reach their breeding grounds, and their numbers and habits vary to meet the conditions found. In 1890 the season was favorable. They arrived at English Lake in some numbers by May 4, and were there found in the open meadows, where hunters were shooting snipe. They were never known to be as abundant as they were May 11. The majority had apparently just arrived, and were scattered through the marshes. They did not seem to be paired. In 1891 but a few were found by May 10. Owing to the low stage of the water, they seemed to be located in certain parts of the marsh, and not so generally distributed as they usually are when they first arrive. In May they frequent the meadows back from the marshes, where they probably breed (Deane).

Dr. F. Stein informs me they are not rare in Gibson and Knox counties. Possibly some remain and breed through the summer. It is said 14 to 20 eggs are sometimes found in one nest, arranged at least two deep, and that the bird begins sitting before the set is complete, so the young hatch at different times. As the summer wears away they begin to wander southward, frequenting not only marshes, but meadows, clover fields, and wheat stubble. One was killed with a whip in a meadow near Brookville, July 15, 1886, by M. A. Remy. August 13, 1897, my son, Will, brought me a Sora which was found near the telephone line. Perhaps it was killed by flying against the wires. Throughout the latter part of August and most of September they are passing. Meanwhile the great numbers of old and young are collecting in northern Indiana and other States until the marshes fairly swarm with them. This is the season for Rail shooting. They are very sensitive to cold. A sudden heavy frost comes, and the myriad voices of the marsh one day are silenced and their owners flown when the sun of the morrow rises. Generally all are gone before the end of September. I have, however, taken them at Brookville October 2, 1887, and October 14, 1890. Mr. J. G. Parker, Jr., informs me that some remain through October in the vicinity of Chicago.

Rail shooting on the tide-water marshes of the Atlantic coast is a popular sport, and many there are who avail themselves of it. This is only true to a very limited extent in this State. Most people do not look upon the Rail as a game bird. In fact, it is known to but very few of our people at all. Its short, rounded wings and inadequate powers of flight would lead one to question whether it could cover the

distance between its breeding grounds and winter home. They are hard to flush, and after a short flight drop among the reeds or grass and are not seen again. Prof. W. W. Cooke says "it can be found throughout the year in southern Illinois." (Bird Migration in Miss. Valley, p. 87.)

Subgenus *COTURNICOPS* Bonaparte.

79. (215). *Porzana noveboracensis* (Gmel.).

Yellow Rail.

Synonym, *LITTLE YELLOW RAIL.*

Above, varied with blackish and ochrey-brown, and thickly marked with narrow white semicircles and transverse bars; below, pale, ochrey-brown, middle belly white, deepest on the breast, where many of the feathers are tipped with dark brown; flanks, rufous, with many white bars; secondaries and lining of the wing, white; a brownish-yellow streak over the eye.

Length, 6.00-7.75; wing, 3.00-3.60; bill, .50-.60; tarsus, .95-1.00.

RANGE.—North America; most common east of Rocky Mountains. Breeds from Indiana north to Nova Scotia and Hudson Bay. Winters from Illinois south to Cuba and Bermuda.

Nest, of grass, on ground in marsh. *Eggs*, 6 or more; creamy buff; densely sprinkled and speckled on larger end with rusty brown; 1.12 by .83 (Ridgw. Manual).

Rare migrant; summer resident, very local; probably breeds.

The small size of this Rail renders it undesirable from the point of view of the sportsman. This, coupled with its retiring ways and slowness to take wing, render it so inconspicuous that while it is often seen yet but few who see it recognize it. My first acquaintance with it was near Brookville in the fall of 1879. A farmer was plowing in a field in September through which ran a slight depression, which was usually damp, and there grew some sedges and rank grass. One round a Yellow Rail ran out of the growth ahead of the horses. He stopped the team and ran after it. The bird did not attempt to fly, and was easily caught. He also caught at least one other and saw still more. He brought the bird to me and I visited the place a day or two after, on September 18. All the ground was plowed except a narrow strip of the wet land. From that, after some effort, I succeeded in flushing two of the birds, which I secured.

Those who have met with the Yellow Rail agree that it is the dryer marshes or wet prairies or meadows that it prefers; the more decidedly marshy ground is frequented by the larger Rails.

Prof. J. A. Balmer, of Pullman, Wash., and a former resident of Vincennes, writes: "The Little Yellow Rail interests me very much. While in Knox County, snipe hunting, each spring, especially in April, I used to find (on particular swamps only) an abundance of this tiny Rail. My old Gordon setter would point by a tussock, and as I walked up to flush, he would nose into the grass and bring out a Yellow Rail, always quite unharmed. I have seen him repeat this act as many as a half dozen times in a single day.

"They were always abundant in spring in this particular part of Males Prairie. I have found them in the fall while quail hunting, but this rarely." He thinks that it breeds there, as he has found it in the breeding season.

Except the eggs found May 17 at Winnebago, Ill., by J. W. Tolman, which are in the collection of the Smithsonian Institution, I know of none that are claimed to be of this bird. Dr. Coues says of this set of six: "They are the only ones I have seen, and differ from those of *P. carolina* in the color of the ground, which is a rich, warm buffy-brown, marked at the greater end with a cluster of reddish-chocolate dots and spots. Size, 1.15 by .85 to 1.05 by .80." (Birds of N. W., p. 539.)

Prof. Evermann met with it near Bloomington in August, 1885, where one specimen was taken alive in a marsh. It was noted at Worth, Ill., September 22, 1891 (Parker). Thus, in August and through September they are migrating to their winter homes. Some of them do not go very far; others reach the Gulf of Mexico. As it is said to winter in central Illinois (Cooke), it may remain some winters in southern Indiana. It generally migrates early in April, reaching our northern swamps some years as early as April 2. Sometimes, however, it is found migrating in May. The latest spring record I have is three specimens taken by Mr. G. G. Williamson, at Muncie, May 12, 1890. It has been reported from but few localities. Mr. Chas. Dury informs me that in his own collection and that of the Cuvier Club, Cincinnati, O., there are specimens from Vincennes, Chalmers and English Lake. It has been taken in Clinton County (Newlin), and Mr. Forest West reports one taken at Adams, Decatur County, in the spring of 1889. Mr. C. E. Aiken says while it is seldom seen, it occurs in considerable numbers in Lake County. He took it at Water Valley in 1889.

Compared with the larger Rails, it is apparently a rare bird in Indiana. Mr. Wm. S. Perry, of Worcester, Mass., has in two different years found them in some part of the Kankakee Marsh. The exact locality I have been unable to determine. He first visited the place on

April 18, 1876, when he found two, and to know more of this species, he was led to return in the spring of 1885. He gave an account of his experience, which will illustrate their comparative abundance, to Mr. Ruthven Deane, who very kindly supplied me with it. Speaking of the Yellow Rail, he says: "I consider them quite rare. I hunted every day for six weeks, especially for Rails, and probably started 1,500 Virginia, 1,500 Sora, 200 King and 5 Yellow. I think that is about the proportion they occur, although with the experience I had, I could probably find more if I should try again. I found the Yellow Rail in a very small part of the marsh, say 50 acres in extent, rather high ground that is not so boggy and wet as where the other species of Rail were plenty. They come very late in April and possibly late in March. The five I have I got between April 2 and 13."

Subgenus *CARCISCUS* Cabanis.

***80. (216). *Porzana jamaicensis* (GMEL).**

Black Rail.

SYNONYM, LITTLE BLACK RAIL.

Upper parts, blackish-brown, finely speckled and barred with white; the hind neck, dark chestnut; head and under parts, dark slate color, paler or whitening on the throat and blackish on the crown; the lower belly, flanks and under wing and tail coverts, blackish, barred with white; some of quills and tail feathers, with white spots; size, very small.

Length, 5.00-6.50; wing, 2.50-3.20; bill, .50-.60; depth of bill through base, .20-.25; tarsus, .85-1.00.

RANGE.—America, from Chili and West Indies, north to Massachusetts, Ontario, Michigan, north Illinois and Oregon. Limits of breeding range unknown; probably breeds throughout United States range. Winters from Gulf coast south.

For nest and eggs, see below.

Rare summer resident locally.

This is one of the rarer American birds, by far the rarest of its family. It is only known from two localities in Indiana, in both of which it undoubtedly breeds. April 22, 1888, Mr. Ruthven Deane identified it at English Lake, and that remained the only Indiana record for over six years. July 27, 1894, Jesse Earlle and Alexander Black identified the Black Rail among the "saw grass" about the "Mill Pond" near Greencastle, Ind. The bird ran, but they could not compel it to fly. Finally they lost it. July 28 they again saw the bird, but could not get it to fly. They searched for it after this,

but could not find it until July 31. On that day they secured a dog, by the aid of which it was flushed, but it was at too close range to shoot. August 1 they again took with them a dog, which caught in its mouth a young Black Rail, too small to fly. The search was continued, and finally an adult male of the same species was found and secured.

The following are the measurements of the male Black Rail, fresh killed, before skinning:

Length, 6.50; wing, 3.00; bill, .60; tarsus, 1.00; tibia, 1.50; tail, 1.40; extent, 10.00.

Young, 4.40; tarsus, 1.00; bill, .50; tibia, 1.50. No tail yet.

The birds were very kindly placed in my collection. Prof. J. A. Balmer shot one while quail shooting one fall on Allison Prairie, Lawrence County, Illinois, across the Wabash River from Vincennes, Ind.

There are only two records from Ohio. Mr. Chas. Dury mentions two birds seen and one taken near Ross Lake, near Carthage, O., May 17, 1890. (Journ. Cin. Soc. Nat. Hist., Vol. XIII, No. 2, 1890, pp. 97, 98.)

Between May 16 and 30, 1891, six males and a female were taken at the same lake. From the female, which was obtained May 30, an egg nearly fully developed was taken. (Dury and Kellogg, *Ibid.*, Vol. XIV, No. 1, p. 44.)

Considering the lateness of the date and the development of the egg, it is very probable these birds would have bred there. Mr. Dury notes when the bird was flushed it would fly but a short distance and alight, and it was almost impossible to flush it a second time.

The only account of its nest and eggs is that given by Mr. E. W. Nelson. In *Birds of Northeastern Illinois*, pp. 134, 135, he notes it breeding near Chicago. The nest was found June 19, 1875, and contained ten fresh eggs. "The nest was placed in a deep cup-shaped depression in a perfectly open situation on the border of a marshy spot, and its only concealment was such as a few straggling *carices* afforded. It is composed of soft grass blades, loosely interwoven in a circular manner. The nest, in shape and construction, looks much like that of a Meadow Lark. The following are its dimensions in inches: Inside depth, 2.50; inside diameter, 3.25; outside depth, 3.50; outside diameter, 4.50. The eggs are a creamy white, instead of clear white, as I stated in a recent article (*Bull. Nuttall Orn. Club*, Vol. I, p. 43), and average 1.00 by .81 inches. They are nearly perfectly oval and are thinly sprinkled with fine reddish-brown dots, which become larger and more numerous at one end. Minute shell markings in the form of dots are also visible. Owing to the small diameter of the nest, the eggs were in two layers."

Dr. Coues gives the size of some eggs in the Smithsonian Institution as 1.05 by .80. The eggs are much larger in proportion to the size of the bird than are those of the Yellow Rail, and they differ from the eggs of that species and of the Sora, which have, respectively, buffy-brown and drab ground color.

SUBFAMILY GALLINULINÆ. GALLINULES.

39. GENUS IONORNIS REICHENBACH.

81. (218). *Ionornis martinica* (LINN.).

Purple Gallinule.

Head, neck and under parts, beautiful purplish-blue, blackening on the belly, the crissum white; above, olivaceous green, the cervix and wing coverts tinted with blue; frontal shield, blue; bill, red, tipped with yellow; legs, yellowish. *Immature*.—With the head, neck and lower back, brownish; the under parts, mostly white, mixed with ochrey.

Length, 12.50-14.00; wing, 7.00-7.50; bill (including frontal shield), 1.85-1.95; tarsus, 2.25-2.50.

RANGE.—America, from Brazil north to South Atlantic and Gulf States, casually to Ontario, Maine, northern Ohio, northern Illinois, Wisconsin and Missouri. Breeds northward to southern Illinois and South Carolina. Winters from Florida south.

Nest, built among rushes over the water; the taller rushes are bent down and woven together as a support; or on ground in marshes. *Eggs*, 8-9; cream color, finely dotted with chestnut-brown and umber; size, 1.55 by 1.13.

Rare visitor in spring and perhaps summer resident.

This bird has been taken in southern Indiana but a few times, and has never been reported north of the latitude of Indianapolis, though both in Ohio and Illinois it reaches their northern boundary. So far as I have information, the occurrences have all been in the spring, and are either wanderers beyond their customary breeding range or rare summer residents in suitable situations. They could hardly be migrants going much farther north, as northern Indiana is nearly, if not quite, the limit of their breeding range. There is no record of its occurrence in Michigan. The first record for Indiana was taken near Brookville in the spring of 1880. Mr. E. L. Guthrie took a specimen in Decatur County in May, 1883. Mr. W. C. DeWitt notes two specimens taken in Wayne County. Mr. E. W. Nelson tells that Mr. C. N. Holden, Jr., took a male near Chicago in May, 1866, and speaks, upon Dr. Hoy's authority, of a specimen taken near Racine, Wis.

Dr. Langdon says: "Dr. Hunt informs me of the capture of this species near the mouth of the Big Miami River on March 31, 1877," (Cat. Birds Vic. Cin., 1877, p. 16). The mouth of the river mentioned is in Indiana, but I do not know the location of the site where the specimen was taken. Three other specimens are noted from the vicinity of Cincinnati that same spring. It was taken near Circleville May 10, 1877. (Wheaton, Birds of Ohio, p. 514.) Prof. E. L. Moseley informs me of the capture of a Purple Gallinule near Sandusky, O., April 28, 1896 (The Auk, Vol. XIV, No. 2, April, 1897, p. 200). Mr. Thomas McIlwraith notes the capture of a specimen at Pickering, Ontario, in April, 1892 (Birds of Ontario, 1894, p. 123). The nest is made in the tall grass along the edges of water courses, bending the grass down and weaving it together. In South Carolina the nest is said to be built in rushes over the water. Besides its true nest, the bird makes several "shams," often as many as five or six (Davie). The bird may be readily recognized by its bright purplish-blue colors.

40. GENUS GALLINULA BRISSON.

***82. (219). *Gallinula galeata* (LIGHT.).**

Florida Gallinule.

Head, neck and underparts, grayish-black, darkest on the head, paler or whitening on the belly; back, brownish-olive; wings and tail, dusky; crissum, edge of wing and stripes on the flank, white; bill, frontal plate and ring around tibiae, red, the former tipped with yellow; tarsi and toes, greenish. *Downy Young*.—Glossy black, throat and cheeks, with silvery-white hairs.

Length, 12.00-14.50; wing, 6.85-7.25; bill (to end of frontal shield), 1.70-1.85; tarsus, 2.10-2.30.

RANGE.—America, from Brazil and Chili north to Maine, Ontario and Minnesota. Breeds from that limit south. Winters from Gulf States south.

Nest, of reeds and rushes on foundation of similar growth, near water level in marshes, sloughs or reedy places in lakes. *Eggs*, 8-13; brownish-buff, thickly spotted with reddish-brown; 1.74 by 1.19.

Regular migrant. Summer resident among the more extensive swamps and marshes. Locally common; some places abundant. Breeds.

It is resident throughout the Southern States, and our summer birds return south and many winter in the same region. They come north in spring, through April and early May. The earliest record I have is

Greencastle, April 6, 1894 (Earlle), and the earliest for the White-water Valley is from Brookville, April 28, 1883. In 1885, 1890, 1892 and 1896 the first record from Indiana was on the same date each year, though in 1892 Mr. Parker had reported it from Cook County, Illinois, May 2. During the migration they are often caught in barnyards, chicken yards, fenced town lots and other places where the fences are rather tightly built. Whether this is due to the fact that they are attracted there or during their nocturnal flight they are generally distributed, and the others pass on, leaving those only which cannot get away, it is impossible to tell.

Judging from their numbers in some swamps, I should think them much more common migrants in southern Indiana than we generally suppose. During the breeding season their numbers vary in different localities. Some places they are by no means common and in others they breed abundantly. Mr. Nelson says of it in Cook County, Illinois: "Abundant summer resident everywhere in the marshes and the larger prairie sloughs; generally has a full set of eggs, numbering from seven to twelve, the first week of June," (*Birds of Northwestern Illinois*, p. 135). In Lake County both Mr. Toppan and Mr. Parker note it as common, and the last-named gentleman says of it about George and Wolf lakes: "The boys collect hundreds of their eggs every year." It is found in the rank slough grass bordering the lakes, and rarely takes to wing when approached.

Mr. C. E. Aiken informs me in May, 1871, in Lake County, he found it breeding very abundantly, but it appeared rare at Whitewater in 1886, 1887 and 1889.

In Starke County, at English Lake, it breeds in limited numbers (Deane, Dury). Also, at Davis Station (Coale). In one locality in that county Mr. Joseph E. Gould found the nests of the Pied-billed Grebe, Coot and Florida Gallinule, full sets of which were taken July 1, 1891. One nest of the Gallinule contained thirteen eggs. It has also been observed breeding in Dekalb County (Mrs. Hine, R. W. McBride); Vigo County (Evermann). The summer of 1897 it was not found at English Lake in the numbers usually observed (Deane). I take the liberty of giving Dr. Langdon's excellent account of its breeding habits as observed the week ending July 4, 1890, in Ottawa County, Ohio, where it breeds abundantly: "The nests are situated amongst the 'saw grass' and constructed of dried blades. Their height varies, some almost resting on the water, while others are placed afloat or more above it, and have an incline eight or ten inches in width, made of dried grass, extending from the nest to the water's edge, which makes them a conspicuous object when the surrounding vegetation is

not too dense. The dozen or so sets of eggs taken were in various stages of incubation, and a few young were observed following their parents. The young when a day or two old are about the size of a newly hatched domestic chicken, and, when found in the open water, are easily captured. They present a curious sight, paddling for dear life, with their bright, red and orange bills standing out in strong contrast with their sooty-black, down-covered bodies." (Journ. Cin. Soc. Nat. Hist., Vol. III, No. 3, October, 1880, p. 228.)

No doubt, the same story prevails everywhere—that these birds are not so numerous or so unsuspicious as they once were, but, on the contrary, are rapidly diminishing in numbers and becoming much more shy.

In addition to the places mentioned, it has been noted in the following counties during the spring migrations: Marion (Noe), Putnam (Clearwaters), Steuben (H. W. McBride), Delaware (Bain), Rush (Voorhees), Boone (Beasley). I have no account of it in the State in the fall later than August 2, 1896, when Mr. Parker reported it common at Hammond. What becomes of it in the fall? In all of the many records I have examined from Indiana, Michigan, Ohio and Illinois and in the reports gathered by Prof. Cooke from the Mississippi Valley, I fail to find a single record of it in the fall. Mr. Parker says it departs early in September.

SUBFAMILY FULICINÆ.

41. GENUS FULICA LINNÆUS.

*83. (221). *Fulica americana* GMEL.

American Coot.

Adult.—Dark slate, paler or greenish below, blackening on the head and neck, tinged with olive on the back; crissum, whole edge of wing and top of secondaries, white; bill, white or flesh-colored, marked with reddish-black near the end; feet, dull olivaceous. *Immature*.—Similar, paler and duller; frontal shield rudimentary. *Downy Young*.—Blackish, white, below; head and neck, with orange hairlike feathers, which are also found less numerous and paler on the upper parts; bill, orange-red, black tipped.

Length, 13.00-16.00; wing, 7.25-7.60; bill (to commencement of frontal shield), 1.25-1.60; tarsus, 2.00-2.20.

RANGE.—America, from Central America and West Indies north to Alaska and casually to Greenland. Breeds throughout its range. Winters in Southern States and southward.

Nest, of marsh vegetation, attached to reeds, afloat in water like a Grebe's or on ground. *Eggs*, 6-15; dull buff, with fine dots of dark brown or black; 1.74 by 1.19.

Common migrant. Northward summer resident. Locally very common. It may sometimes, favorable winters, winter southward.

Usually their period of migration begins in March, but some years they do not reach the northern part of the State until after the first of April. The following dates give the time of first appearance at Brookville for a series of years: 1881, April 25; 1882, April 18; 1883, April 3; 1884, March 12; 1886, April 3; 1887, March 31; 1888, March



Frontal Plate of a Coot.

26; 1889, March 28; 1896, April 4. The latest date noted, same locality, was May 16, 1884. The variation in northern Indiana is as marked. The first one seen at Waterloo in 1896 was April 5; in 1897, March 20 (Feagler). The first seen at Laporte in 1893 was April 1; in 1894, March 16 (Barber). Usually, however, the early birds are a very few of the advance guards, and the majority cannot be depended upon to arrive for from one to three weeks later. It was common at Waterloo April 6, 1896, and not until April 9, 1897. It was common at Laporte in 1893 April 10, and April 1, 1894. As with some other species of retiring, marsh-loving birds, it is often reported from its favorite localities northward before it has been seen farther south. In 1891 a single bird was seen at English Lake, February 14 and 15. In 1892 a pair were seen there March 6, and they were numerous March 20. In 1894 about a dozen were noted March 7 and

quite a number March 18 (Deane). It was observed in Cook County, Illinois, March 20, 1885 (Parker). Further south it was first noted in Carroll County April 8, 1885 (Evermann). The first one was noted at Greencastle in 1892 April 8 (Earlle), and in 1894 at Delphi March 8. They are usually not common until April 1. The first arrivals come singly or a few together, but towards April 1 to 10 they appear in flocks of twenty or thirty, or sometimes more. They are usually abundant throughout the month of April and sometimes to May 11. At times they are seen upon the smaller lakes by thousands, but are rarely found on Lake Michigan (Parker). Some years the migrants remain in numbers after the summer residents begin to breed. The latter pair through April. By the first week in May they are mostly paired, and May 11, 1890, Mr. Deane found a nest at English Lake, made of broken dried cane, with a very small depression, containing eight eggs. Mr. Joseph E. Gould took full sets of fresh eggs from the same locality July 1, 1891. Those that remain to breed are generally a very small portion of the Coots found with us in April. In 1891 Mr. Aiken reported it still an abundant summer resident in Lake County, but less plentiful than twenty years ago. They are said to breed in the following counties besides those noted: Dekalb (Feagler), Laporte (Barber), Boone (Beasley), Lake (Meyer, Aiken, Parker).

Coots and Gallinules are generally known as "Mud Hens." The former may, however, be readily distinguished by the white bill, which is conspicuous for quite a distance. While Coots often associate with ducks, and swim, and sometimes act, something like them, they do not rise and fly away as ducks do. They either swim to, or by a short flight find, concealment among the reedy or grassy edges of the place they frequent.

In fall they again become very abundant on our lakes, and remain so until freezing weather. With October 1 they commence passing southward, and may be noticed over the southern part of our State from that time until cold weather. Most of them, however, are seen there through October, and we see very little of the great number that remain upon the northern waters, to be driven south in a body by the November cold. The first fall migrant noted at Brookville was October 1, 1889, and the latest October 21, 1886. Mr. Parker reports them from Cook County, Illinois, November 14, 1892, and November 11, 1893.

The latest record I have for Indiana is from Carroll County, where Prof. Evermann observed it November 21, 1884. It has been noted in our State every month in the year except December and January.

G. ORDER LIMICOLÆ. SHORE BIRDS.

XVII. FAMILY PHALAROPODIDÆ. PHALAROPES.

a ¹ . Bill broad, somewhat triangular at tip.	CRYMOPHILUS. 42
a ² . Bill slender, tapering to a point.	PHALAROPUS. 43

42. GENUS CRYMOPHILUS VIEILLOT.

84. (222). *Crymophilus fulicarius* (LINN.).

Red Phalarope.

Adult in Summer.—Under parts, with sides of neck and upper tail coverts, dark purplish or wine-red, with glaucous bloom; top of head and around bill, sooty; sides of head, white, this color meeting on the nape; rump, white; back, black, all the feathers edged with tawny or rusty brown; quills, brownish-black, with white shafts, and much white at bases of webs, the coverts dark ash; the ends and interior webs of the greater row, white; some of the secondaries entirely white; bill, yellowish, with dusky tip; feet, yellowish. *Adult in Winter*.—Head all around and entire under parts, white, with a dusky circumocular area, and nuchal crescent, and a wash of ashy along sides of body; above, nearly uniform ash; wings, ashy-blackish, the white cross-bar very conspicuous; bill, mostly dark.

Length, 7.50-8.75; wing, 5.25-5.50; culmen, .80-.95; tarsus, .80-.85.

RANGE.—Northern parts of Northern Hemisphere, breeding in the Arctic regions and migrating south in winter. In the United States south to the Middle States, Ohio Valley and Cape St. Lucas. Chiefly maritime.

Nest, a shallow depression in ground, rarely lined. *Eggs*, 3-4; drab-olive, olive-buff or pale brown, heavily spotted with dark brown; 1.24 by .86.

Rare straggler during migrations.

Phalaropes are queer little birds. They look like Sandpipers, but their lobate feet, resembling those of Coots and Gallinules, at once distinguish them. They seem to be Sandpipers when along the shore, but upon the water, swim as well as Coots. This species is more often found along the sea coast than in the interior, where it is indeed very rare.

Mr. R. R. Moffitt informs me he killed one of these Phalaropes in Jasper County April 10, 1885, and Prof. B. W. Evermann says one was procured by Dr. J. T. Scoville, near Terre Haute, October 23, 1889.

The following notes are taken from the interesting account of this bird in its summer home along the Arctic seas by Mr. E. W. Nelson:

"This handsome Phalarope arrives at the Yukon mouth and adjacent parts of the Bering Sea coast during the last few days of May or first of June, according to the season. It is a common summer resident at Point Barrow, where it arrives early in June and remains till the sea closes, in October. For a week or two after its arrival fifty or more flock together. In the morning, after the birds were paired, they could be found scattered here and there by twos over the slightly flooded grassy flats. At times these pairs would rise and fly a short distance, the female in advance, and uttering now and then a low and musical 'clink, clink,' sounding very much like the noise made by lightly tapping together two small bars of steel. A little later in the day, their hunger being satisfied, they begin to unite into parties, until fifteen or twenty birds would rise and pursue an erratic course over the flat. As they passed swiftly along, others would join them, until the number would be increased to two hundred or four hundred, perhaps. During all their motions the entire flock moves with such unison that the alternate flashing of the under side of the wings and the dark color of the back, like the play of light and shade, makes a beautiful spectacle. Very early in June the females have each paid their court and won a shy and gentle mate to share their coming cares. The eggs are laid in a slight depression, generally on the damp flats, where the birds are found. There is rarely any lining to the nest. Toward the end of June most of the young are hatched, and by the middle of July are on the wing. Soon after the young take wing these birds, gathering in flocks, frequent the sea. They breed all along the Arctic shores of Alaska and Siberia, wherever suitable flats occur, and even reach those isolated islands forever encircled by ice, which lie beyond" (Natural History Coll. in Alaska, pp. 97, 98).

43. GENUS PHALAROPUS BRINSON.

α^1 . Membranes of toes scalloped; wing under 4.50. Subgenus PHALAROPUS.

P. lobatus (Linn.). 85

α^2 . Membranes of toes not scalloped; wing over 4.50. Subgenus STEGANOPUS Vieillot.

P. tricolor (Vieill.). 86



Foot of Northern Phalarope.

Subgenus PHALAROPUS.

85. (223). Phalaropus lobatus (LINN.).**Northern Phalarope.**

Adult in Summer.—Above, sooty-gray, with lateral stripes of ochraceous or tawny; neck, rich, rust-red, nearly or quite all around; under parts otherwise, white, the sides marked with the color of back; upper tail coverts like back, some lateral ones white; wings, blackish, the ends of the greater coverts broadly white, forming a conspicuous cross-bar, continued on some of the inner secondaries; bill and feet, black. Varies much in plumage with age and season, but easily recognized by the small size and generic characters. *Immature.*—Lacks chestnut.

Length, 7.00-8.00; wing, 4.00-4.45; culmen, .80-.90; tarsus, .75-.80.

RANGE.—Northern portions of Northern Hemisphere, breeding in Arctic latitudes. South in winter to Guatemala and Bermuda.

Nest and Eggs, similar to those of Red Phalarope, but eggs smaller; 1.20 by .82.

Rare migrant. Mr. C. A. Stockbridge informs me he has observed it at Ft. Wayne. Two were taken in Boone County June 7, 1889. They were all that were seen, and appeared to be mated. (J. E. Beasley.) This is very late for them to be found here. These two birds are now in the State Museum at Indianapolis.

The following extracts are taken from Mr. Nelson's account of this bird's habits: "As summer approaches, on the Arctic shores and coast of Bering Sea, the ducks and geese fill the air with their loud, resounding cries, and the rapid wing strokes of arriving and departing flocks add a heavy bass to the chorus which greets the opening of another glad season in the wilds of the cheerless north.

"Amid this loud-tongued multitude suddenly appears the graceful, fairylike form of the Northern Phalarope. The first arrivals reach Saint Michaels, in full plumage, from May 14 to 15, and their number is steadily augmented until the last few days of May and first of June, when they are on hand in full force and ready to set about the season's cares. Every pool now has from one to several pairs of these birds gliding in restless zigzag motion around its border. They may be watched with pleasure for hours, and present a picture of exquisite gentleness, which renders them an unfailing source of interest. The female of this bird, as is the case with the two allied species, is much more richly colored than the male, and possesses all the 'rights' demanded by the most radical reformers.

"As the season comes on when the flames of love mount high, the dull colored male moves about the pool, apparently heedless of the

surrounding fair ones. Such stoical indifference appears too much for the feelings of some of the fair ones to bear. A female coyly glides close to him and bows her head in pretty submissiveness, but he turns away, pecks at a bit of food, and moves off. She follows, and he quickens his speed, but in vain; he is her choice, and she proudly arches her neck, and in mazy circles, passes and repasses before the harassed bachelor. He turns his breast first to one side and then to the other, as though to escape, but there is his gentle wooer ever pressing her suit before him. Frequently he takes flight to another part of the pool, all to no purpose. If with affected indifference he tries to feed, she swims along side by side, almost touching him, and at intervals rises on wing above him, and, poised a foot or two over his back, makes a half dozen sharp wing strokes, producing a series of sharp, whistling noises, in rapid succession.

"In the course of time, it is said, that water will wear the hardest rock, and it is certain that time and importunity have their full effect upon the male of this Phalarope, and soon all are comfortably married, while *mater familias* no longer needs to use her seductive ways and charming blandishments to draw his notice. About the first of June the dry, rounded side of a little knoll, near some small pond, has four dark, heavily marked eggs laid in a slight hollow, upon whatever lining the spot affords, or more rarely upon a few dry straws and grass blades brought and loosely laid together by the birds.

"Here the captive male is introduced to new duties, and spends half his time on the eggs, while the female keeps about the pool close by. In due time the young are hatched, and come forth beautiful little balls of buff and brown.

"By the middle to the 20th of July the young are fledged and on the wing. Soon after the old and young begin to gather in parties of from five to a hundred or more and seek the edges of large ponds and flats of the muddy parts of the coast and borders of the tide creeks. They are last seen about the last of September or first of October" (Nat. Hist. Coll. in Alaska, pp. 99, 100).

Subgenus STEGANOPUS. VIEILLOT.

*86. (224). *Phalaropus tricolor* (VIEILL.).

Wilson's Phalarope.

Adult Female in Summer.—Forehead, crown and middle back, pearl-gray, the former with blackish line on each side; stripe on each side of head, and down the neck, deep black, changing to rich dark chestnut, and continuing along sides of back and on scapulars; neck

and breast, buffy-cinnamon; other lower parts, upper tail coverts, nape, stripe above eyes, cheeks, chin and throat, white. *Adult Male in Summer*.—Smaller and much darker in color. *Winter Plumage*.—Upper parts, pale gray; lower parts, white; chest and sides of breast, tinged with ashy. *Immature*.—Brow, back and scapulars, blackish-dusky; feathers margined with buffy; neck tinged with buffy. The upper tail coverts, superciliary stripe, and most of lower parts being white in all these plumages will greatly aid in identification.

Length, female, 9.40-10.00; wing, 5.20-5.30; bill, 1.30-1.35; tarsus, 1.30-1.35; adult male, length, 8.25-9.00; wing, 4.75-4.80; bill, 1.25; tarsus, 1.20-1.25.

RANGE.—America; Patagonia and Brazil, north to Oregon, Saskatchewan and Nova Scotia; chiefly inland. Breeds from northwestern Indiana and Utah north. Winters south of United States.



Head of Wilson's Phalarope. Natural size.

Nest, of grass, in slight depression, in ground, in marsh or damp meadows. *Eggs*, 3-4; grayish-buff, varying to brownish-buff, thickly speckled or spotted with dark brown or brownish-black.

Rare migrant. Summer resident northward. Common in extreme northwestern part of the State. Breeds.

They migrate in spring in late April and May. The earliest record from this State is from Kouts. A specimen taken there April 30, 1890, by Mr. J. W. Gano is in the collection of the Cuvier Club, Cincinnati, O. (Dury.) Mr. Eliot Blackwelder found a pair in Cook County, Illinois, April 21, 1895. Mr. C. E. Newlin informs me that one was killed near Frankfort about May 11, 1883, and another one about the same date in 1877. Five or six were seen and a pair taken near Lebanon, in Boone County, May 9, 1889. They were received by Mr. J. E. Beasley, who prepared them for the State Museum at Indianapolis.

Mr. Ruthven Deane shot one from a small flock at English Lake May 10, 1890. Mr. C. E. Aiken has observed it at different points in Lake County, notably at Water Valley. Mr. G. L. Toppan says in that county it occasionally is a common summer resident, and breeds.

Mr. J. G. Parker, Jr., informs me of its breeding in Lake County. He says they are common about July 4, and usually leave for the south very early, generally by the last of July or first of August. Occasionally they may be found well into September. I have shot these birds in Cook County, Illinois, near the Indiana line, late in May.

They are not found numerously east of the vicinity of the lower end of Lake Michigan. Mr. A. L. Kumlein calls our attention to the fact that the female is not only more brilliant in plumage, but also larger than the male. The female pursues the male during the pairing season. The male attends to the duties of incubation almost entirely alone. (Field and Forest, July, 1876.)

To Mr. E. W. Nelson, who is authority on all matters relating to these graceful yet queer Phalaropes, we are indebted for our knowledge of its habits. He studied it in Cook County, Illinois, and he may occasionally have crossed into Indiana. At any rate, since birds do not know political boundaries, we shall assume that they behave in the same manner in Illinois that they do in our own State, and I shall give a portion of his account of his observations. He found their nests from May 25 to June 25. (B. N. O. C., II, 1877, pp. 40-43.)

In northern Illinois, where the following observations were made, Wilson's Phalarope is the most common summer resident, occurring about grassy marshes and low prairies, and is not exceeded in numbers by even the ever-present Spotted Sandpiper. As is the case with several other species of birds, Lake Michigan appears to form a limit to its common occurrence in the eastern portion of its range.

On the west it extends to the Rocky Mountains, and between these limits it has been recorded during the breeding season from the Saskatchewan to Arkansas (Coues), and to the City of Mexico (Nuttall.) It is more closely confined to its favorite haunts than most water birds, and this may in a measure account for the little hitherto known regarding its habits. During the first two weeks of May, the exact date varying with the season, this beautiful bird first makes its appearance in northeastern Illinois. Its arrival is heralded by a few females, which arrive first, and are found singly about the marshes. At this time the females have a peculiar harsh note, which I have heard but a few times, and only from solitary individuals, before the arrival of the main body.

A few days later small flocks, embracing both sexes, may be found along the borders of grassy pools or lying at midday on the sunny side of some warm knoll in the marsh. As the breeding season approaches they become more restless, flying from place to place, and

finally separate into small parties of two or three pairs. About the middle of May their love-making commences, and is at first indicated by the increasing solicitude they show for each other's welfare. The appearance of a person in their vicinity at this time is the signal for all the birds near to come circling about, though not within easy gunshot. By a careful approach one may now and then find a small party swimming about in some secluded pool.

The charming grace of movement exhibited at such times, combined with their tasteful elegance of attire, form one of the most pleasing sights one could witness as they swim buoyantly from side to side of the pool, gracefully nodding their heads, now pausing an instant to arrange a feather or to daintily gather some fragment of food, and now floating idly about, wafted by the slight breeze, which at intervals ripples the surface of the water. A more common, but scarcely less pleasing sight, is presented when, unconscious of observation, they walk sedately along the border of the water, never departing from their usual grace of movement. Their food is generally found in such places, where the receding water furnishes a bountiful supply. The only demonstrations I have observed during the pairing time consist of a kind of solemn bowing of the head and body; but sometimes, with the head lowered and thrust forward, they will run back and forth in front of the object of their regard, or again, a pair may often be seen to salute each other by alternately bowing or lowering their heads; but their courtship is characterized by a lack of the rivalry and vehemence exhibited by birds.

The nesting is usually in some thin tuft of grass on a level spot, but often in an open place concealed only by a few straggling blades of small carices. The male scratches a shallow depression in the soft earth, which is usually lined with a thin layer of fragments of old grass blades, upon which the eggs, numbering from three to four, are deposited about the last of May or first of June. Owing to the low situations in which the nests are placed, the first set of eggs is often destroyed by a heavy fall of rain, causing the water to rise so as to submerge the nest. In this case, the second set, numbering two or three, are often deposited in a depression, scratched in the ground, as at first, but with no sign of any lining. Accidents of this kind cause the second set of eggs to be deposited sometimes as late as the last of June.

The young usually appear about the third week of June, and are able to fly in about three weeks. Generally a number of pairs nest upon the same marsh. In some instances as many as fifty may be counted within the radius of a mile; but notwithstanding this, their

nests are extremely difficult to discover—the material and the color of the eggs correspond so closely to the appearance of the surrounding surface. If they are disturbed while building, the nest is usually abandoned. Incubation is attended to by the male alone. The female, however, keeps near, and is quick to give the alarm upon the approach of danger. The females are frequently found at this time in small parties of six to eight, and should their breeding ground be approached, exhibit great anxiety, coming from every part of the marsh to meet the intruder, and, hovering over his head, utter a weak, nasal note, which can be heard only a short distance. This note, which is possessed by both sexes, is nearly always made while the birds are in the air, and its production requires, evidently, considerable effort, the head and neck being inclined downward, and then suddenly raised as the note is uttered, the flight being at the same time momentarily checked. The movements of the birds usually render it an easy matter to decide whether or not they have nests in the immediate vicinity. After the first alarm, those having nests at a distance disperse, while others take their course in the form of an ellipse, sometimes several hundred yards in length, with the object of their suspicion in the center, and with long strokes of their wings, much like the flight of a Killdeer, they move back and forth. As their nests are approached the length of their flight is gradually lessened, until at last they are joined by the males, when the whole party hover low over the intruder's head, uttering their peculiar note of alarm. At this time they have an ingenious mode of misleading the novice by flying off to a short distance and hovering anxiously over a particular spot in the marsh, as though there were concealed the object of their solicitation. Should they be followed, however, and a search be made there, the maneuver is repeated in another place and still farther from the real location of the nest. But should this ruse prove unavailing, they return and seem to become fairly desperate, flying about one's head, almost within reach, manifesting great distress.

If possible, still greater agitation is shown when they have unfledged young, they even betraying their charge into the hands of the enemy by their too obvious solicitude, they then hovering directly over the young and uttering their notes of distress. The young have a fine, wiry peep, inaudible beyond a few feet. They are very pretty little creatures, covered with yellowish-buff colored down, with black spots on the upper surface of the body. Even when first hatched, they are quite lively and difficult to capture.

About the middle of July the females suddenly disappear, and a little later the males and young also leave, with the exception of a few

stragglers, which occasionally remain until the last of August. The main portion rarely remain as late as the 10th, and are usually gone by the 5th. The males commence their fall moult before they leave; but I have never taken a specimen in which the winter plumage was very evident.

XVIII. FAMILY RECURVIROSTRIDÆ. AVOCETS AND STILTS.

*a*¹. Toes 4; bill curved upward, flattened.

RECURVIROSTRA. 44

*a*². Toes 3; bill nearly straight, not flattened.

HIMANTOPUS.

44. GENUS RECURVIROSTRA LINNÆUS.

87. (225). *Recurvirostra americana* GMEL.

American Avocet.

Adult in Summer.—White; primaries and scapulars, black; head, neck and breast, mostly light cinnamon. *Adult in Winter and Immature*.—Similar; head, neck and breast more or less tinged with bluish-gray.

Length, 15.50-18.75; wing, 8.90-9.00; bill, 3.40-3.65; tarsus, 3.70-3.80.

RANGE.—North America; Guatemala and West Indies, north to Saskatchewan and Great Slave Lake. Rare on Atlantic coast. Breeds locally from Illinois north. Winters from Gulf coast south.

Nest, depression in ground in marsh. *Eggs*, 3-4; brownish-drab, spotted with chocolate; 1.93 by 1.35.

Rare migrant. I only know of one record for Indiana. Mr. Chas. Dury informs me of a specimen in the collection of the Cuvier Club, Cincinnati, O., which was taken at "Calumet" Lake, Indiana. It is equally rare in Ohio and Michigan, but perhaps is more often found in Illinois, where Nelson gives it as a rare migrant, in small parties, the last of April and first of May and during September and the first half of October.

XIX. FAMILY SCOLOPACIDÆ. SNIPES, SANDPIPERS, ETC.

*a*¹. Tarsus with long transverse scales in front only; bill very long, curved downward. NUMENIUS. 58

*a*². Tarsus with long, transverse scales both in front and behind.

*b*¹. Eyes far back, directly above ears; bill long; tip of upper mandible thickened; plumage unchanging. Subfamily SCOLOPACINÆ.

*c*¹. Thigh entirely feathered; three outer primaries attenuate.

PHILOHELA. 45

- c*². Thigh naked below; three outer primaries not very narrow. GALLINAGO. 46
- b*². Eyes not far back, considerably before the ears; tip of upper mandible thin; summer and winter plumage different. Subfamily TRINGINÆ.
- d*¹. Toes 3. CALIDRIS. 51
- d*². Toes 4.
- e*¹. Toes not webbed.
- f*¹. Bill not shorter than middle toe with claw; inner webs of quills not mottled. TRINGA. 49
- f*². Bill shorter than middle toe with claw; inner webs of quills mottled. TRYNGITES. 56
- e*². Toes more or less webbed at base.
- g*¹. Tail more than half the length of the wing. BARTRAMIA. 55
- g*². Tail not more than half the length of the wing.
- h*¹. Tail longer than bill from frontal feathers.
- i*¹. Wing less than 4 inches long. EREUNETES. 50
- i*². Wing not less than 4 inches long.
- j*¹. Bill narrower at tip; upper surface hard and smooth.
- k*¹. Exposed culmen less than one-fifth as long as wing. PAVONCELLA.
- k*². Exposed culmen more than one-fifth as long as wing.
- l*¹. Wing less than 4.50 inches long. ACTITIS. 57
- l*². Wing over 4.50 inches long.
- m*¹. Bill slender; legs dusky or yellow. TOTANUS. 53
- m*². Bill stout; legs bluish. SYMPHEMIA. 54
- j*². Bill slightly widened at tip; upper surface slightly wrinkled or pitted. MICROPALAMA. 48
- h*². Tail shorter than bill.
- n*¹. Tip of both mandibles with a groove in middle and also pitted and wrinkled. MACRORHAMPHUS. 47
- n*². Tip of both mandibles not grooved, smooth. LIMOSA. 52

45. GENUS PHILOHELA GRAY.

88. (228). *Philohela minor* (GMEL.).

American Woodcock.

Occiput, with thin, transverse bands of black alternating with thin, narrower ones of yellowish; rusty above, variegated and harmoniously blended black, brown, gray and russet; three outer primaries very narrow and stiff; below, pale warm brown of variable shade.

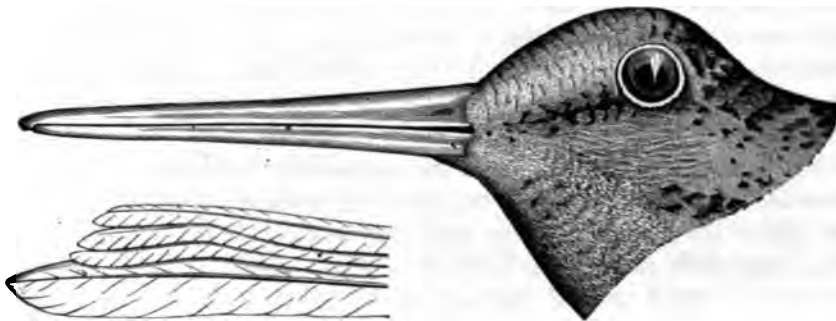
Length, 10.50-11.75; wing, 4.80-5.70; bill, 2.50 to nearly 3.00; tarsus, 1.25.

RANGE.—Eastern provinces of North America, north to Labrador, Manitoba and York Factory; west to Nebraska and Dakota. Breeds throughout its range. Winters from Indiana and Virginia southward.

Nest, on ground in woods or thicket, of leaves. Eggs, 4; buffy, spotted with rusty brown and purplish-gray; 1.51 by 1.14.

Summer resident. Common in suitable localities. Some years, at least, resident in the southwestern part of the State, especially the Wabash Valley, and perhaps about moist places that do not freeze throughout the State.

It has been reported from Grand Rapids, Mich., January 1, 1888. (Cook, Birds of Michigan). Prof. E. L. Moseley reports one that had been wounded, shot near Sandusky, O., in midwinter. The winter of 1888-9 they wintered in the lower Wabash Valley. Prof. J. A. Balmer says they were frequently seen that winter along the open creeks on the prairies near Vincennes. Mr. E. J. Chansler reports them wintering in the same region the winter of 1896-7.



American Woodcock, showing attenuate primaries. Natural size.

They migrate very early in spring, sometimes in February. Mr. H. W. McBride reported them from Dekalb County February 14, 1890. Usually, however, the greater number migrate in March and early April. The following records for the first arrival in spring for several years in Indiana and Michigan are given: Brookville, 1884, March 21; Petersburg, Mich., 1887, March 2; 1888, March 15; 1889, March 23; Petersburg, Mich., 1897, March 20 (J. Trombley); Elkhart, 1891, March 29; Greencastle, 1892, March 10 (Black); 1893, March 10 (Earlle); Laporte, 1894, April 2; Indianapolis, 1895, March 8 (Noe); Edwards, Vigo County, 1896, March 11. It will be observed that the earliest dates are usually from northern Indiana and Michigan. In other words, they were noted at an earlier date from those localities than from places much farther south. In fact, they were found in the northern part of our State from two to four weeks before they were supposed to appear in the valleys of the White and Whitewater, in the southern half of the State. This indicates that they proceed at once, at the earliest possible date, to their favorite breeding grounds, and those who know where they are, or who accidentally happen upon them, find them.

Farther south, where they breed in very limited numbers, and where the conditions they desire are not often found, it is only rarely they are seen, and then during the later migrations or the mating season. In the vicinity of Brookville I have generally found them between April 1 and 15. Upon their arrival they are found in thickets along the shores of lakes, rivers and small streams, where the ground is wet and soft, so it can be easily probed with the long, sensitive bills, for their favorite food, earthworms. Sometimes, however, they are found far from such situations during the spring migrations. April 1, 1897, I found two in rather open woods, on the top of a dry ridge, over three hundred feet above the river valley, near Brookville. They are nocturnal not only in their migrations, but generally in all their movements. The early migrants begin mating soon after arrival; the later ones frequently come paired. One of the notable characteristics of the mating time is the series of aerial evolutions and the nocturnal song of the male.

Mr. Jesse Earle and Mr. Alexander Black observed these repeated several times on two successive evenings, at Greencastle, March 10 and 11, 1892. The first evening they could not determine the bird, but the next night they secured the performer, which proved to be a male Woodcock. Mr. Eugene P. Bicknell, in the *Auk*, Vol. II, July, 1885, pp. 261, 262, gives an excellent account of this feature of the mating habits, which he observed April 19, 1884: "The birds would start up from amid the shrubbery, with a tremulous, whirring sound of the wings, rising with spiral course into the air. The spiral varied considerable in pitch, sometimes expanding to sweep far out over the neighboring fields, where a single evolution would carry the bird upward almost to the extremity of its flight, which was sometimes directly over the point of departure. The rapid trilling sound with which it started off, as Woodcocks do, continued without interruption during the ascent, but gradually became more rapid, and as the bird neared its greatest height, passed into pulsations of quavering sound. Each pulsation was shorter and faster than the last, and took the tremolo to a higher pitch, sounding like a throbbing whirr of fine machinery or suggesting in movement the accelerating, rhythmic sound of a railway car gradually gaining full speed after a stop. At last, when it seemed as if greater rapidity of utterance was not possible, the vertex of the flight would be reached, and descending with increasing swiftness, the bird would break forth into an irregular chippering, almost a warble, the notes sounding louder and more liquid as it neared the earth. Suddenly there would be silence, and a small, dark object would dart past through the dusk, down amid the shrub-

bery. Then, at silent intervals, a single strange and rather startling note, a loud, sharp and somewhat nasal *speat* or *spneat*, which sounded as if delivered with a spiteful directness at some offensive object."

Audubon says they ascend in these spiral girations fifty or more yards in height, and he thought the sounds made after reaching the ground were calls to the female, who, hearing them, flies to the male. After pairing comes nesting. The nests are generally but depressions in some higher, dry spot in a swamp or wet woods or underbrush. I have, however, found the nest among the bushes on a sandy knoll over a hundred yards from water or swampy ground. There is much that is generally known regarding its habits in summer and fall, but few comparatively are they who have seen its eggs or observed its breeding habits or heard its song. I have found its nest and eggs March 24 (1884) and as late as April 16 (1881). Mr. G. G. Williamson found them at Muncie March 29, 1889, and I have records from other localities, different years, as early as March 28 and 23.

Mr. V. H. Barnett, Spearsville, observed an old Woodcock, "with four young, as large as chickens, just hatched, April 13, 1894," and Mr. Oliver Davie records young seen near Cleveland, O., as early as April 9. It is a fact, attested by careful observers, that the Woodcock will carry its young away from danger between its feet. By July 1 the young are quite well grown; in most cases are as strong of wing as the parents. Then shooting begins. They still frequent the same choice cover until the dry, late summer hardens the ground and absorbs the water and they are driven by necessity from much of their feeding ground to seek more desirable places. The summer of 1894 was very dry. Through August of that year, the late Mr. C. F. Goodwin, of Brookville, observed a Woodcock in his yard night after night for at least two weeks. His home was on the principal street of the town; the ground was heavily sprinkled and was soft and the grass green and well trimmed. The bird came close to his window and was quite tame. The yard was lighted by an electric street light, so its actions could easily be noted with a glass. The bird would busy itself by the hour prodding the ground with its bill, and every little while would pull out a worm. They have the power of moving the tip of the upper mandible, so they can use the bill as a forceps to withdraw their food. In the American Field, Vol. XLIV, December 28, 1895, my friend, Mr. L. H. Haymond (a son of the pioneer in Indiana ornithology), has contributed an excellent article on this bird from the standpoint of a sportsman. Its habits are so changeable, and so frequently it is the unexpected that happens, that this writer says he is almost compelled to deduce the maxim "never to be surprised at anything a

Woodcock does." He shows that they change their localities through summer, as food is easy or hard to obtain; that to one who has studied their favorite grounds they are to be found there through all the late summer and fall; that they feed by day as well as by night, at times, at least. In fall they are sometimes to be found in cornfields and damp meadows. Conditions make demands upon them, and they seem always to be equal to the emergency. In the fall they may possibly occasionally begin their migrations in October. They are reported then, but whether the ones observed are summer residents or migrants is not known. I have observed them at Brookville until November 10, and from reports obtained, they sometimes stay until the end of that month. Their leaving depends upon the weather. A hard freeze, sufficiently severe to prevent them boring, will cause them to go south.

Dr. B. H. Warren, State Ornithologist of Pennsylvania, recording the result of his investigations of the food of Woodcocks as ascertained by dissection, found the young examined contained "small fragments of worms." The food of others was earthworms, beetles, larvæ, and one had eaten a spider. One specimen, taken November 8, had fed exclusively on small seeds (Birds of Pennsylvania, p. 80).

46. GENUS GALLINAGO LEACH.

***89. (230). Gallinago delicata (ORD.).**

Wilson's Snipe.

Crown, black, with a pale middle stripe; back, varied with black, bright bay and tawny, the latter forming two lengthwise stripes on the scapulars; neck and breast, speckled with brown and dusky; lining of wings, barred with black and white; tail, usually of sixteen feathers, barred with black, white and chestnut; sides, waved with dusky; belly, dull white; quills, blackish, the outer white-edged.

Length, about 10.50-11.50; wing, 5.00-5.60; tail, 2.60; bill, 2.50-2.70.

RANGE.—America; Columbia and West Indies, north to Labrador, Hudson Bay and Alaska. Breeds from northern Indiana and Connecticut north. Winters in Indiana, Ohio, Illinois and South Carolina south.

Nest, a depression in a grassy meadow. *Eggs*, 3-4; pale olive, olive-grayish or pale olive-brown, heavily spotted, especially on larger end, with deep brown and purplish-gray; 1.55 by 1.09.

Abundant migrant. Summer resident northward; some winters a few remain in suitable localities. It was taken by Mr. W. O. Wallace

in Wabash County January 1, 1892, and within a week before that date two others were killed in that county. Mr. E. J. Chansler thinks some may winter in Knox County. Prof. E. L. Moseley reports one killed at Grand Rapids, Mich., December 24, 1896, and several others a few days before. The same authority tells me they have been taken a number of times in midwinter several miles west of Sandusky, Ohio, where there are springs and running water that do not freeze in severe weather. The migrants begin to move early in March. The following dates give that of the first appearance for each of several years, at the places named: Brookville, 1881, March 29; 1882, March 29; 1883,



Wilson's Snipe.

April 7; 1886, March 18; 1896, March 7; Cook County, Ill., 1884, March 22; 1885, March 29 (Parker). English Lake, 1887, March 7 (Deane). Macsauber Club, Kankakee River, 1890, March 23 (Deane). Frankfort, 1893, March 16; 1895, March 8 (Ghere). Greencastle, March 5 (Earlle). Edwards, Vigo County, 1897, March 11 (Kendrick).

The first migrants generally appear in March, but it is usually the last of the month or early in April before they become common. Usually after the warm rains have softened the earth and brought into activity the insects, beneath the surface, they appear. March, 28, 1896, was a day when the snow melted in the sun, yet was to be seen upon the frozen ground, in the shade. I saw a snipe by the side of the road as I drove along. It seemed quite tame, and flew ahead of me a short distance and alighted again and again in the ditch. At last it arose and attempted to alight on a frozen snow-bank, evidently thinking it was water. It seemed very much surprised when it came down upon something hard, for it descended with some force, and as soon as it could recover, arose and flew away. Usually in the White-water Valley, they are gone by the 20th to 25th of April; but in 1881,

they remained with us as late as May 6. Mr. Ruthven Deane says more or less of Wilson's Snipe breed at English Lake, every year. Mr. G. Frean Morcom has a set of eggs taken at the Macsauber Club, 25 miles farther up the Kankakee River. It has also been reported as breeding in the following other counties: Lake (Meyer and Parker); Miami (Cunningham). They have been observed in midsummer in Wabash County (Wallace). They vary much in numbers and time of appearance in spring. The same thing is noticeable in fall. They are very peculiar in their movements and in the selection of a feeding ground. Some days they lie close, and others rise almost out of range of the gun. They utter, as they arise and fly against the wind, a note commonly called "scape," from its resemblance to that sound, and move away rapidly in a zigzag flight, that is very perplexing to the inexperienced sportsman.

In the fall, they usually begin to arrive in northern Indiana from the north, early in September, but are not common until later in the month. They remain about the marshes through October and often till late in November. The fall of 1889 was notable for the unusually early appearance of these birds in numbers on their favorite grounds. This was noted by all collectors and sportsmen.

Mr. Parker observed it in Lake County and Mr. Ruthven Deane wrote me as follows concerning them: "On September 1st they were so numerous a good shot could have killed forty or fifty birds in many localities in Indiana and Illinois. Of course a number breed every year but something has driven them by thousands from the north, some claiming it is due to very dry weather north of us." The earliest record I have for southeastern Indiana is Sept. 23, 1884. From that time they are passing through October and November. The latest record at Brookville is November 17, 1894, but elsewhere it has been reported later, and in some localities as stated, winters. "Morning and evening and throughout cloudy days in the early part of the breeding season the male has a curious habit of mounting high overhead, then descending obliquely for some distance, and as it turns upward, strikes rapidly with its wings, producing a loud whistling sound with each stroke. This maneuver is repeated again and again, and appears to be performed for the same purpose as is the 'booming' of the night-hawk. Besides this sound Wilson's Snipe has a peculiar sharp cry during this season, which is uttered when the bird is disturbed. I first became acquainted with this note in May, 1876, when, while walking along a marshy strip of land, I was surprised to hear a loud ka-ka-ka-ka-ka, uttered with great force and in a rather loud, harsh tone. Turning quickly I was still more astonished to find the author

to be one of these birds. It was flying restlessly from post to post along a fence and showed the greatest uneasiness at my presence, the notes being repeated at short intervals. Although the nest was probably near I could not discover it" (Nelson's Birds of N. E. Ill.). According to Audubon, "the food of our common Snipe consists principally of ground-worms, insects, and juicy, slender roots, of different vegetables, all of which tend to give its flesh that richness of flavor and juicy tenderness for which it is so deservedly renowned, it being equal to that of the woodcock. Many epicures eat up both snipe and woodcock with all their viscera, worms, insects to boot, the intestines, in fact, being considered the most savory parts. On opening some newly killed snipe, I have more than once found fine, large and well-fed ground-worms, and at times a leech, which I must acknowledge, I never conceived suitable articles of food for man, and for this reason I have always taken good care to have both snipe and wood-cocks well cleaned, as all game ought to be."

Dr. B. H. Warren examined 25 snipe and found articles of food were beetles, water beetles, and earthworms, together with weed seeds, grass blades and the roots of plants. (Birds of Pa., 1890, p. 82.)

47. GENUS *MACRORHAMPHUS* LEACH.

α^1 . Length 11.00, or less.

M. griseus (Gmel.). 90

α^2 . Length over 11.00.

M. scolopaceus (Say). 91

90. (231). *Macrorhamphus griseus* (Gmel.).

Dowitcher.

Synonyms, GRAY SNIPE, GRAY BACK.

Tail and its coverts, at all seasons, conspicuously barred with black and white (or tawny); lining of wings, and axillars, the same; quills, dusky; shaft of first primary, and tips of the secondaries, except long inner ones, white; bill and feet, greenish-black. In summer, brownish-black above, variegated with bay; below, brownish-red, variegated with dusky; a tawny superciliary stripe and a dark one from bill to the eye. In winter, plain gray above and on the breast, with few or no traces of black; the belly, line over eye and under eyelid, white.

Length, about 10.00-11.00; wing, 5.25-5.90 (average, 5.65); bill, 2.00-2.55 (2.30); tarsus, 1.20-1.55 (1.35).

RANGE.—America, from Brazil and West Indies north to Arctic Ocean. Breeds within Arctic Circle. Winters from Gulf coast south.

Nest, a hollow in ground, lined with grass. Eggs, 3-4, resemble those of Wilson's Snipe; 1.65 by 1.13.

Rare migrant, more often seen in July, August and September after breeding season. These are usually young birds, they are generally found in flocks of three to ten. They accompany the Yellow-legs, Pectoral, Least and Semipalmated Sandpiper. Mr. F. M. Woodruff, of Chicago, informs me he has a bird of this species in his collection that was taken September 9, 1892. He has notes of it in Cook County, Ill., near the Indiana line, May 6, 1893; September 23, 1893; and Mr. J. G. Parker, Jr., has taken it three times in July; July 4, 1887; July 19 and 21, 1893.

I do not know the relative numbers of the two forms of this bird found within the State, but think that this will prove to be much the rarer.

91. (232). *Macrorhamphus scolopaceus* (SAY).

Long-billed Dowitcher.

Synonyms, GREATER GRAY-BACK, RED-BELLIED SNIPE.

Adult in Summer.—Similar to *M. griseus* but averaging larger; abdomen, pale cinnamon, like rest of lower parts. Bill larger. *Winter plumage and Immature* known from last species by larger size.

Length, 11.00-12.50; wing, 5.40-6.00 (average 5.74); bill, 2.10-3.00 (2.72); tarsus, 1.35-1.75 (1.58).

RANGE.—South America, north to Alaska, principally migratory through Mississippi Valley and Western States. Not common on Atlantic coast. Breeds in Alaska. Winters from Gulf coast south.

Nest and Eggs, indistinguishable from those of *M. griseus*.

Rare migrant. Of all the references to Dowitcher only one refers to the short-billed form. That I have mentioned under the last mentioned species. All others are referred to here, but as most of them are claimed to represent this form it is probably by far the most common with us. In the spring it is noted in March, April and May, and later it probably appears in July, and remains through August like the last mentioned bird. The earliest record I have for the State is March 11, 1889. On that date one specimen was taken and another seen at English Lake (Deane). Mr. Jesse Earlle took a specimen at Greencastle May 14, 1890, and the next day Mr. Alex. Black took another which has been very kindly placed in my collection. On May 28 or 29, 1891, another one was taken by Mr. Black. Mr. Dury reports this species in spring and fall, from English Lake. He also notes it from English Lake, and one from Kouts, Ind., April 30, 1890. These localities are represented by specimens in the Cuvier Club col-

lection, Cincinnati, Ohio. Mr. C. E. Aiken informs me that he has observed it occasionally in Lake County in flocks.

Mr. E. W. Nelson found this one of the most common waders on the shore of Norton's Sound, in summer, and it is also present in smaller numbers all along the Yukon, where there are suitable localities. He found it at the Yukon mouth, May 12, and toward the end of that month they were plentiful, and their curious habits and loud notes make them among the most conspicuous denizens of the marshes. There they mate and nest. The following is a description of a set of four eggs taken there June 16: "The eggs, four in number, rested in a shallow depression formed by the bird's body in the soft moss and without a trace of lining. These eggs measures respectively 1.80 by 1.21; 1.70 by 1.20; 1.69 by 1.20; 1.72 by 1.23."

48. GENUS MICROPALAMA BAIRD.

92. (233). *Micropalama himantopus* (Bonap.).

Stilt Sandpiper.

Adult in Summer.—Above, blackish, each feather edged and tipped with white and tawny or bay, which on the scapulars becomes scalloped; auriculars, chestnut; a dusky line from bill to eye, and a light reddish superciliary line; upper tail coverts, white, with dusky bars; primaries, dusky, with blackish tips; tail feathers, ashy-gray, their edge and a central field, white; under parts, mixed, reddish, black and whitish, in streaks on the jugulum, elsewhere in bars; bill and feet, greenish-black.

Immature and Adult, in Winter.—Ashy-gray above, with or without traces of black and bay, the feathers usually with white edging; line over the eye, and under parts, white; the jugulum and sides, suffused with the color of the back, and streaked with dusky; legs, usually, pale.

Length, 7.50-9.25; wing, 5.00-5.30; bill, 1.55-1.75; tarsus, 1.55-1.70.

RANGE.—America, from Brazil, Peru and West Indies, northeast of Rocky Mountains to Arctic regions. Breeds within the Arctic Circle. Winters in Louisiana and southward.

Nest, depression in ground, lined with grass and leaves. *Eggs*, 3-4, light-drab, or grayish-white, with bold spots and marknigs of chestnut-brown; 1.42 by 1.00.

Rare migrant. Found in this latitude in April, July and August, September and October. I have no spring records. The only Indiana record is of a specimen taken by L. A. and C. D. Test, at Hedley's Lake, October 10, 1892. This is in my collection, for which the

collectors have my thanks. Mr. E. W. Nelson reports two occurrences near Chicago, one August 8, 1873, the other, September 10, 1873. (Birds N. E. Ill., p. 126.) Mr. J. G. Parker, Jr., collected a bright female, from a flock of four at Mud Lake, July 25, 1893, and a young bird August 7, 1893. Mr. F. M. Woodruff reports it from Cook County, Ill., near the Indiana line, April, 1890; July 25, 1893, and September 23, 1893 (The Auk, April, 1896, p. 180), and Mr. J. G. Parker, Jr., adds from the same vicinity the record of a young bird August 7, 1893. In Ontario, Mr. McIlwraith has noted it June 25, July 28, and September 23 and 26. Since it breeds far to the northward, there seem to be individuals wandering about, every month from June to October, some of which, perhaps, do not go to the breeding grounds.

49. GENUS TRINGA LINNÆUS.

- α¹. Wing 6.00, or more; middle pair of tail feathers not longer than the rest. Subgenus TRINGA. **T. canutus** Linn. 93
- α². Wing under 6.00; middle pair of tail feathers longer and more pointed than the rest.
 - β¹. Tarsus about equal in length to bill.
 - c¹. Wing more than 4.00. Subgenus ACTODROMAS Kaup.
 - d¹. Wing 5.00, or more; rump and middle upper tail coverts plain black or dusky. **T. maculata** Vieill. 94
 - d². Wing less than 5.00; middle upper tail coverts plain dusky. **T. bairdii** (Coues). 95
 - c². Wing under 4.00; size very small. **T. minutilla** Vieill. 96
 - β². Bill very long, nearly as long as tarsus and middle toe; decidedly curved downward at the end. Subgenus PELIDNA Cuvier. **P. alpina pacifica** (Coues). 97

Subgenus TRINGA.

93. (234). **Tringa canutus** LINN.

Knot.

Adult in Summer.—Above, brownish-black, each feather tipped with ashy-white, and tinged with reddish on scapulars; below, uniform brownish-red, much as in the robin, fading into white on the flanks and crissum; upper tail coverts, white with dusky bars, tail feathers and secondaries, grayish-ash with white edges; quills, blackish; gray on the inner webs and with white shafts; bill and feet, blackish.

Immature.—Above, clear ash, with numerous black and white semi-circles; below, white, more or less tinged with reddish, dusky speckled on breast, wavy barred on sides.

Length, 10.00-11.00; wing, 6.50; tail, 2.50; tail, nearly square.

RANGE.—Sea coasts, throughout the Northern Hemisphere; south in winter to Brazil, New Zealand, Damara Land, Africa and Australia. Breeds in the Arctic Circle. Resident on Gulf coast (McIlhenny). In migrations, visits the larger inland waters.

Nest, a depression in the sand. *Eggs*, light pea-green, closely spotted in brown with small specks about the size of a pin head; 1.10 by 1.00.

Rare migrant. It seems, in the interior, to be almost exclusively found along the great lakes. Mr. McIlwraith notes it in May and June, in Ontario; Dr. Wheaton noted it in Ohio, and Mr. E. W. Nelson in Cook County, Ill., in May, September, and October.

Mr. F. M. Woodruff shot a Knot—a beautiful specimen, in the light gray juvenile plumage, with scale-like markings of pure white on the back,—on the shore of Lake Michigan, at Miller's, Ind., August 24, 1896. It was in company with a miscellaneous flock of Sandpipers. August 21, 1897, Mr. Woodruff took three young of the year, two males and one female, at the same place.

In an article in "The Auk," for January, 1893, p. 25, Mr. Geo. H. Mackay, in speaking of the Knot on the New England coast, says: "It formerly sojourned there in great abundance, but now appears in greatly reduced numbers." He explains this diminution in numbers is owing to their destruction by the practice of "firelighting," which formerly prevailed, but which is now prohibited by law.

"The mode of procedure was for two men to start out after dark at half-tide, one of them to carry a lighted lantern the other to reach and seize the birds, twist their necks, and put them in a bag slung over the shoulder. When near a flock, they would approach them on their hands and knees, the birds being almost invariably taken on the flats." They are said to have been shipped by the barrel to Boston, as many as six barrels having been observed in one shipment. Mr. MacKay says: "It is not my intention to convey the impression that the Knots are nearly exterminated, but they are much reduced in numbers, and are in great danger of extinction, and comparatively few can be seen in Massachusetts, where formerly there were twenty to twenty-five thousand a year, which I consider a reasonable estimate of its former abundance."

The extensive range of the Knot is a matter of general information, yet as is often the case, we know much more about many birds with comparatively restricted habitat. During our winter it reaches Australia, New Zealand, Damara Land, Africa, but in America it has not been reported south of Brazil. Very little is known of its breeding grounds. It has been reported building from such far north points

as Melville Peninsula, shores of Smith Sound, north Georgian Islands, and Grinnell Land, but its eggs remained absolutely unknown, until Lieut. A. W. Greely took it on the *Lady Franklin Bay* expedition, in the vicinity of Fort Conger, latitude $81^{\circ} 44' N.$ (*The Auk*, II, p. 313).

SUBGENUS ACTODROMAS KAUP.

94. (239). *Tringa maculata* (VIEILL.).

Pectoral Sandpiper.

Middle tail feathers pointed, projecting a quarter of an inch beyond the rest, wedge-shaped at the end, dusky, edged with lighter; outer tail feathers, pale brownish-gray, edged with white; rump and upper tail coverts, black, the under feathers of latter, whitish, marked with dusky; above, feathers black, each one bordered with light clay color, brighter on crown, back, scapulars and tertials, throat and rest of under parts, white; below, neck and breast, light grayish-buff, streaked with black. This species resembles *T. bairdii* but is larger, has black instead of dusky upper tail coverts, and middle tail feathers longer and more pointed.

Length, 8.00-9.50; wing, about 5.00-5.50; bill, 1.10-1.20; tarsus, 1.00-1.10.

RANGE.—America, from Brazil and Chili north to Arctic Ocean.

Breeds in north Alaska and other Arctic regions. Winters from West Indies to South America. Accidental in Europe.

Nest, in grass. *Eggs*, 4, pale grayish-buff, ranging to pale olive-greenish, boldly and heavily blotched with rich vandyke brown; 1.44 by 1.02.

Common, sometimes abundant, migrant, generally in flocks. A few may be summer residents.

Usually found from the latter part of March to May 1, and through September and October. The earliest record I have is from Vigo County, March 17, 1897 (Kendrick). I have also the following early spring records: Brookville, March 29, 1881; Greencastle, March 28, 1894; March 22, 1895 (Earlle); Greensburg, March 27, 1894; March 26, 1896 (Shannon); Liverpool, March 29, 1885; Cook County, Ill., March 20, 1886 (Parker). Some years the first reported appearance is much later, as is shown by the following: Brookville, April 9, 1887; Greencastle, April 8, 1890 (Earlle). The following are dates when last observed in spring migrations: Brookville, May 6, 1881; Knox County, April 24, 1894 (Chansler); English Lake, May 10, 1891; May 6, 1888 (Deane); Laporte, May 6, 1896 (Barber). Sometimes they are seen singly or in small flocks of five to twelve, but often in

large droves of forty or fifty to several hundred. They frequent swampy ground, but throughout the southern part of the State I have usually found them most abundant upon the poorly drained and wet meadows, through the month of April.

In the Whitewater Valley they were the most abundant I ever saw them the spring of 1881. Their unusual abundance throughout the Wabash Valley was noted in the spring of 1894.

- They go into the Arctic regions to breed. Mr. Nelson found them breeding in Alaska at the mouth of the Yukon River, and Mr. Murdock at Point Barrow. The former gives a bit of his experience with these birds on an island in the Yukon delta the last of May, 1879.
- On the night of May 24th as he lay wrapped in his blanket with the tent flap raised, he says: "As my eyelids began to droop and the scene to become indistinct, suddenly a low, hollow, booming note struck my ear, and sent my thoughts back to a spring morning in northern Illinois, and to the loud vibrating tones of the prairie chickens. Again the sound came nearer and more distinct, and with an effort I brought myself back to the reality of my position, and resting upon one elbow listened; a few seconds passed and again arose the note; a moment later, and, gun in hand, I stood outside the tent. The open flat extended away on all sides, with apparently not a living creature near. Once again the note was repeated close by, and a glance revealed its author. Standing on one leg in the thin grasses ten or fifteen yards from me, with its throat inflated until it was as large as the rest of the bird, was a male *A. maculata*. The note is deep, hollow, and resonant, but at the same time liquid and musical, and may be represented by a repetition of the syllables too-u, too-u, too-u, too-u, too-u, too-u, too-u, too-u. Before the bird utters these notes it fills its cesophagus with air to such an extent that the breast and throat are inflated to twice or more its natural size, and the great air sack thus formed gives the peculiar resonant quality to the note. At times the male rises to twenty or thirty yards in the air and inflating its throat glides down to the ground with its sack hanging below. Again he crones back and forth in front of the female, puffing his breast out and bowing from side to side, running here and there as if intoxicated with passion. Whenever he pursues his love-making, his rather low but pervading note swells and dies in musical cadences, which form a striking part in the great bird chorus heard at this season of the year, in the north. The Eskimo name indicates that its notes are like those of the Walrus, hence the term "Walrus-talker." (N. H. Coll. in Alaska, pp. 108, 109).

As soon as the breeding season is over they begin to return to us. About the lower end of Lake Michigan they are seen some years the latter part of July. In Cook County, Ill., Mr. Parker found them very abundant July 17, 1893, and Mr. J. O. Dunn found them continuing abundant through the remainder of July and well into August. That, however, is an unusual occurrence, the like of which has not been noted in twenty years' observations. In 1889 they were noted August 10th (Parker).

They become common in September, and remain so into October. Lafayette, September 14 to October 5, 1895 (Test). Mr. E. W. Nelson says it sometimes remains in northeastern Illinois until November 1. Messrs. Ulrey and Wallace note that in September they are found in great abundance along the Wabash River (Proc. I. A. S., 1895, p. 150).

95. (241). *Tringa bairdii* COUES.

Baird's Sandpiper.

Adult in Summer.—Middle tail feathers not projecting to any degree beyond the rest and not noticeably pointed; middle upper tail coverts, dusky, bordered with dull clay-color, the lateral ones, white; middle tail feathers, nearly black, others light brownish-gray, all narrowly edged with whitish. Below, chest, pale buff, streaked and spotted with dusky grayish-brown; throat, sides and belly, white. Crown, pale grayish-buff, broadly streaked with brownish-black; scapulars and interscapulars, irregularly spotted with brownish-black and pale grayish-buff, the former largely predominating.

Adult in Winter.—Above, nearly uniform grayish-brown tinged with clay color; jugulum and sides deeply suffused with clay-color or dirty buff, the former very indistinctly streaked. *Immature.*—Above, light buffy-brown, streaked with dusky, the feathers of the back and the scapulars, blackish, conspicuously bordered terminally with dull white; wing coverts, dark grayish, also bordered terminally with white or light buff. Jugulum suffused with buff and indistinctly streaked.

Length, 7.00-7.60; wing, 4.60-4.85; bill, .90-1.00; tarsus, 1.00.

RANGE.—America, from Patagonia and Chili, northward chiefly through interior of North America to Arctic regions; rare on Atlantic coast. Not reported from Pacific coast of North America. Breeds in Alaska and the Barren Grounds, and winters south to limit of its range.

Nest, a slight depression in the ground, lined with grass. *Eggs*, 3-4, light creamy buff, sometimes tinged with rusty, thickly speckled, or spotted with deep reddish-brown or chestnut; 1.30 by .93.

Rare migrant. Up to this time it has been taken in Indiana but twice, both times in August. In fact the single instance given by Dr. Wheaton (*Birds of Ohio*, p. 176) in March, is, except the general reference given by Nelson (*Birds of N. E. Ill.*, p. 127) the only one of its occurrence in the Ohio Valley, or the upper lake basin at that season, that has come to my notice.

It seems to be common in Kansas and Nebraska in spring (Cooke *Bird Mig. in Miss. Valley*, p. 93) and may pass north through this western route.

Mr. W. O. Wallace took a single specimen August 26, 1893, at Wabash, and Mr. J. G. Parker, Jr., has a male taken at Miller's, Ind., August 24, 1896. He was in company with Mr. F. M. Woodruff, who informs me that they saw several, probably five, of these birds. Mr. Parker also has a female taken at Mud Lake, Cook County, Ill., August 22, 1893. It has been taken in Michigan, August 15, 1893 (Covert), August 20, 1895 (Milliken).

In Ohio it has been reported by Dr. Wheaton in September and October. The latest date being one noted by Dury and Freeman, October 27, 1878, at Cincinnati.

This bird is much more numerous farther west, where, in some parts, Dr. Coues says it is the most abundant small sandpiper during migrations.

98. (242). *Tringa minutilla* VIEILL.

Least Sandpiper.

Upper parts in summer, with each feather blackish centrally, edged with light bay and tipped with ashy or white; in winter, and in the immature, simply ashy; tail feathers, gray, with whitish edges, the central, blackish, usually with reddish edges; crown not conspicuously different from hind neck; chestnut edgings of scapulars usually scalloped; below, white, the jugulum with dusky streaks and an ashy or brownish suffusion; bill, black; legs, dusky greenish. Smallest of the Sandpipers.

Length, 5.00-6.75; wing, 3.50-3.75; bill, .75-.92; tarsus, .75.

RANGE.—The whole of America, breeding almost if not entirely north of United States; winters from Gulf coast south. Accidental in Europe.

Nest, a depression in ground, lined with grass. *Eggs*, 3-4; pale grayish-buffy, varying to pale brownish, thickly spotted, speckled or sprinkled with deep chestnut and dull purplish-gray; 1.15 by .83.

Migrant; in spring not common. They pass northward through May, when they are found in small flocks and return, some years, about July 20; leave the last of August or early in September. In the fall they are much more numerous, and in the vicinity of Lake Michigan, are often common, being frequently found in company with Semipalmated Sandpipers. Mr. Nelson found it nesting in Cook County, Ill. (Birds N. E. Ill., p. 127).

The earliest date at which it has been noted in this State is May 2, 1890, at Waterloo (Snyder). It was noted at Greencastle in 1891, May 4 (Hughes); in 1892, May 14, and last seen May 26; in 1895, May 11 (Earle). Mr. H. K. Coale tells me one was shot on the shore of Lake Michigan, in Lake County, Ind., by Mr. Geo. F. Clingman, June 1, 1879. Mud Lake, Cook County, Ill., is a favorite feeding ground of these birds, as in fact of all the Sandpipers and other small shore birds. It may be used as a calendar for recording their arrival and departure. Mr. J. O. Dunn obtained three, there, from a flock of about twenty, July 3, 1893, and he found them afterwards through July and August at the same place.

There Mr. Parker found the Least Sandpiper July 19, 1893, and from that time until August 8th, they were noted. He found them common August 15, 1887, and observed two at Cheltenham, September 6, 1889. It was found at Wolf Lake May 23 and 30, 1896 (Tallman). Messrs. L. A. and C. D. Test obtained it at Hedley's Lake, near Lafayette, September 6, 1894. One specimen was taken from a flock of Solitary Sandpipers in Wabash County August 29, 1893 (Ulrey and Wallace P. I. A. S., 1895, p. 150). I found one at Brookville August 28, 1897.

These little Sandpipers and their companions are commonly called in many localities, "Peeps." Nuttall says that "for the discovery of their food their flexible and sensitive awl-like bills, are probed into the mire, marshy soil or wet sand, in the manner of the snipe and woodcock, and in this way they discover and rout from their hidden retreats, the larvæ and the soft worms, which form a principal part of their fare. At other times they also give chase to insects and pursue their calling with amusing alacrity."

"Fogs hang low and heavy over rock-girdled Labrador. Angry waves pallid with rage exhaust themselves to encroach upon the stern shores, and baffled, sink back howling into the depths. Winds shriek as they course from crag to crag in mad career, till the humble mosses

that clothe the rocks crouch lower still in fear. Overhead the Sea Gulls scream as they winnow, and the Murres, all silent, ply eager oars to escape the blast. What is here to entice the steps of the delicate birds? Yet they have come, urged by resistless impulse, and have made a nest on the ground in some half-sheltered nook. The material was ready at hand, in the mossy covering of the earth, and little care or thought was needed to fashion a little bunch into a little home. Four eggs laid (they are buffy-yellow, thickly spotted over with brown and drab), with the points together, that they may take up less room and be more warmly covered; there is need of this, such large eggs belonging to so small a bird. As we draw near, the mother sees us and nestles closer still over her treasures, quite hiding them in the covering of her breast, and watches us with timid eyes, all anxiety for the safety of what is dearer to her than her own life. Her mate stands motionless, but not unmoved, hard by, not venturing even to chirp the note of encouragement and sympathy she loves to hear.

"Alas! hope fades and dies out, leaving only fear; there is no further concealment—we are almost upon the nest—almost trodden upon, she springs up with a piteous cry and flies a little distance, realighting, almost beside herself with grief, for she knows only too well what is to be feared at such a time. If there were hope for her that her nest were undiscovered, she might dissimulate and try to entice us away by those touching deceits that maternal love inspires. But we are actually bending over her treasures, and deceptions would be in vain; her grief is too great to be witnessed unmoved, still less portrayed; nor can we, deaf to her beseeching, change it into despair. We have seen and admired the home—there is no excuse for making it desolate; we have not so much as touched one of the precious eggs, and will leave them to her renewed and patient care." (Coues, *Birds of N. W.*, p. 483).

Subgenus *PELIDNA* Cuvier.

97. (243a). *Tringa alpina pacifica* (COUES).

Red-backed Sandpiper.

Synonyms, AMERICAN DUNLIN, BLACK BREAST.

Adult in Summer.—Above, chestnut, each feather with a central black field, and most of them whitish-tipped; rump and upper tail coverts, blackish; tail feathers and wing coverts, ashy-gray; quills, dusky with pale shafts; secondaries, mostly white, and inner primaries, edged with the same; under parts, white; belly, with a broad, jet black area; breast and jugulum, thickly streaked with dusky; bill and feet,

black. *Adult in Winter, and Immature.*—Above, plain ashy-gray, with dark shaft-lines, with or without red or black traces; below, white; little or no trace of black on the belly; jugulum, with a few dusky streaks and an ashy suffusion.

Length, 7.60-8.75; wing, 4.60-4.95; bill, 1.40-1.75; tarsus, 1.00-1.15.

RANGE.—North America in general; breeds in Alaska and Arctic regions and eastern Asia. Winters from Gulf coast south; except about Great Lakes, rare in the interior.

Nest, a depression in ground lined with grass or leaves. *Eggs*, 3-4; brownish-grayish or olive buff, blotched, spotted and stained with chestnut-brown; 1.43 by 1.01.

Migrant the latter part of May, early in June and October. Sometimes abundant about the lower end of Lake Michigan and the small lakes near there, in full breeding plumage, in May; elsewhere rare.

Mr. Geo. F. Clingman obtained a specimen of this bird from the shore of Lake Michigan, in Lake County, June 1, 1879 (Coale). Mr. C. A. Tallman informs me, he has taken it at Wolf Lake, in Indiana.

The earliest record I have is from Mr. E. Blackwelder, who took it in Cook County May 18, 1895. Mr. Tallman took it in the same county May 23 and 30, 1896. May 25, 1887, in company with Mr. H. K. Coale, I found it very abundant, in full plumage, between Grand Crossing, Ill., and the Indiana line, and took several specimens.

Mr. F. L. Washburn obtained it at Ann Arbor, Mich., May 14, 1888. Mr. Nelson notes its occurrence as late as June 5, and in the fall says it returns in winter dress during September, and remains well into October (*Birds of Northeastern Illinois*, pp. 127, 128). It does not seem to be as plentiful in fall. Mr. Tallman informs me of taking two specimens at Calumet Lake in October and one at Mud Lake October 12, 1893.

In Alaska it breeds abundantly at the mouth of the Yukon, on the shores of Norton's Sound and at Point Barrow, where they arrive from the 10th to the end of May. They nest from the first of June to the first of July. The young are mostly on the wing toward the end of the latter month, and the birds begin to gather into flocks along the muddy edges of the brackish pools and banks of tide creeks. They leave in October (Nelson, N. H. Coll. in Alaska, pp. 110, 111).

50. GENUS *EREUNETES* ILLIGER.93. (246). *Ereunetes pusillus* (LINN.).**Semipalmated Sandpiper.**

Adult in Summer.—Above, variegated with black, bay and ashy or white, each feather with a black field, reddish edge and whitish tip; rump and upper tail coverts, except the lateral ones, blackish; tail feathers, ashy-gray, the central darker; primaries, dusky, the shaft of the first, white; a dusky line from the bill to the eye, and a white superciliary line; below, pure white, usually rufescent on the breast, and with more or less dusky speckling on the throat, breast and sides; in young birds, usually wanting; in winter the upper parts mostly plain ashy-gray; but in any plumage or under any variation the species is known by its small size and semipalmated feet.

Length, 5.25-6.75; wing, 3.65-3.90 (in male); wing, 3.85-4.00 (in female); bill, .68-.75 (.72) in male; bill, .80-.92 (.84) in female.

RANGE.—America, from Brazil, north to Arctic coast. Breeds from Labrador and Hudson Bay northward. Winters from Gulf coast southward.

Nest, slight hollow in ground, lined with grass. *Eggs*, 3-4; pale, dull, grayish-buff, speckled or spotted with dark brown and purplish-gray; 1.21 by .85.

Migrant; generally uncommon, but often common and perhaps summer resident in vicinity of Lake Michigan, and more numerous in spring than the Least Sandpiper, with which it is often found. In spring they have been noted from the latter part of April into the beginning of June. It is most numerous in May. Prof. Evermann noted it in Carroll County, April 24, 1884, and April 21, 1885. Mr. J. O. Dunn found it common in Cook County, Illinois, June 9, 1894, and obtained six specimens. Mr. Nelson notes that "many remain through summer. From repeated dissections, I am confident that these are barren birds, and probably, as Mr. Maynard suggests, young of the preceding year" (Birds of Northeastern Illinois, pp. 126, 127). Mr. Dunn has also taken it there July 27, 1893, still in summer plumage. And Mr. Parker reports it July 17 and July 26, 1893.

This is another instance of the unusually early migration of such species that year. Usually they do not appear until after the middle of August and remain into September, occasionally to October. Mr. Parker noted it August 19, 1896, in Cook County, Illinois, and August 24, 1896, at Miller's, Ind.

Mr. V. H. Barnett took a specimen in Vermillion County, Indiana, August 30 and 31, 1897. Messrs. L. A. and C. D. Test found it near

Lafayette, at Hedley's Lake, September 6, 1894, and Mr. J. O. Dunn shot one from a flock of five small Sandpipers at Peru October 2, 1893. It had lost one foot and the wound had healed. It has also been reported from Lake County (Woodruff, Aiken); Chalmers and English Lake (Dury); Steuben County (H. W. McBride); Putnam County (Clearwaters). I have never seen it in the Whitewater Valley. The extremely early appearance of a number of the Limicolæ, including the Pectoral and Least Sandpipers and this species on the shore of Lake Michigan about the middle of July, will be noted.

51. GENUS CALIDRIS CUVIER.

99. (248). *Calidris arenaria* (LINN.).

Sanderling.

Adult in Summer.—Above, feathers with black centers edged with rufous or grayish and often tipped with whitish; head, neck, throat and jugulum, pale cinnamon-rufous, speckled below and streaked above with blackish; lower parts, white; greater wing coverts, broadly tipped with white, and outer webs of inner primaries white at their base. *Adult in Winter*.—Above, pale gray, spotted with black and whitish, the latter at tips of feathers; jugulum, white, unspotted, faintly tinged with dull buff.

Length, 7.00-8.75; wing, 4.70-5.00; bill, .95-1.00; tarsus, .90-1.05.

RANGE.—Nearly cosmopolitan, but breeding only in Arctic and subarctic districts; abundant in America, from Hudson Bay north to Arctic coast, migrating south to Patagonia and Chili. Chiefly littoral, but frequenting also the larger inland waters.

Nest, a hollow in ground, lined with grass and leaves. *Eggs*, 3-4; light olive brown, finely spotted with darker, the markings larger and more blended on larger end; 1.41 by .91.

Migrant; most places rare, but very common in late summer and fall on the shore of Lake Michigan and perhaps along the Ohio River.

Mr. Nelson notes it from about the 20th of May to the 10th of June, but in all the observations that have come to my notice I have never found it reported at that season. They appear usually in flocks of five to fifty birds by themselves, but are occasionally associated with other Sandpipers, particularly the Semipalmated and Pectoral, through August. Of those first arriving about one-third are adults, with the reddish, spotted throat of the breeding plumage. They were common at Miller's, Ind., August 1, 1897. There was found a large flock of Sandpipers, many of which were Sanderlings. Two weeks

later, on August 14, at the same place, this species was scarce (Woodruff).

Mr. Parker reports them from same section August 24, 1896, when he found them common, and collected both adults, in rich breeding plumage, and young. In 1886 he noted it in Cook County, Illinois, August 28. He thinks they are not so common in late years. Mr. H. K. Coale found them common on September 11, 1881. He saw them on the shore of Lake Michigan, in Lake County, Indiana. He saw them there again September 2, 1883, and had seen them September 25, 1875. He informed me they were very abundant, and that the feathers were "full of parasites." This is the latest record I have, but Mr. Nelson has them recorded from Cook County, Illinois; as late as October 20. Mr. George L. Töppan has also observed it in Lake County, Indiana. Mr. Dury thinks he had a specimen from English Lake, but has not been able to find it. In Ohio it is common on Lake Erie near Cleveland. Dr. Langdon notes it on the Ohio River near Cincinnati, where it was also taken by Dury and Freeman September 15, 1878. Dr. Wheaton took it near Columbus in October, 1874 (Wheaton, Birds of Ohio, p. 479).

52. GENUS LIMOSA BRISSON.

- α¹. Tail distinctly barred; wing over 8.50. *L. fedoa* (Linn.). 100
 α². Tail black, white at base and tip; wing under 8.50. *L. hæmastica* (Linn.). 101

100. (249) *Limosa fedoa* (LINN.).

Marbled Godwit.

Tail, barred throughout with black and rufous; rump and upper tail coverts like the back; no pure white anywhere; general plumage, rufous or cinnamon-brown; below, breast, sides and flanks, barred with dusky; above, variegated with black and brown or gray; quills, rufous and black; bill, flesh-color, largely tipped with black; feet, dark; large. *Immature*.—Breast, sides and flanks, immaculate.

Length, 16.50-20.50; wing, 8.95-9.00; bill, 3.50-5.06; tarsus, 2.75-3.00.

RANGE.—North America, from Central America and Cuba northward to Manitoba and Saskatchewan. Breeding chiefly in the interior from Iowa and Nebraska northward. Winters from Gulf coast southward.

Nest, on prairie, usually near water. *Eggs*, 3-4; olive-drab to buffy, irregularly blotched and spotted with dark brown and purplish gray; 2.27 by 1.60.

Rare migrant. In former years it was common, and possibly bred. It is reported as breeding in Ohio, Wisconsin and Iowa (Davie). Mr. Chas. Dury tells me it was abundant at Chalmers, Ind., in years past. In Carroll County Prof. Evermann found it in April, 1883. This is the only recent record I can find. Though in 1876 Mr. Nelson considered it a rather common migrant, April 15 to May 15, and September 10 to October 20.

This bird is much more abundant west of the Mississippi River, where it was found breeding abundantly in Traverse Lake region, in western Minnesota, by Messrs. Roberts and Benner (B. N. O. C., Vol. V, 1880, pp. 13, 18). It also breeds in Manitoba.

101. (251). *Limosa hæmastica* (Linn.).

Hudsonian Godwit.

Adult.—Smaller than last species; above, blackish-brown, irregularly spotted and barred with pale ochraceous; rump, blackish; upper tail coverts, white; tail, black, white at base and (narrowly) at tip; primaries, brownish-black, their shafts white; below, chestnut-rufous, barred with black and sometimes tipped with whitish; lining of wings and axillars, black. *Adult in Winter and Immature*.—Above, plain brownish-gray; below, white; breast, shaded with brownish-gray or buffy.

Length, 14.00-16.75; wing, 8.10-8.60; culmen, 2.85-3.45; tarsus, 2.25-2.50.

RANGE.—Eastern North America and the whole of middle and South America. Breeds only in the high north, notably on the Barren Grounds of the Arctic Ocean. Winters south beyond the United States.

Nest, a depression in ground, lined with grass. *Eggs*, 4; deep olive with light and dark brown spots; 2.20 by 1.42.

Rare migrant. I know of no recent instance of its capture. In 1879 Dr. Brayton said it was not very rare about Lake Michigan. This was substantially as Mr. Nelson found it in 1876, when he noted it as occurring from April 15 to May 10, and September to the first of October (Birds of Northeastern Illinois, p. 128). Now I consider it of very rare occurrence. I failed to get any records from my correspondents either in Illinois or Indiana within the last fifteen years. Mr. Ridgway gives it as an abundant migrant.

It has been seen by Mr. McIlwraith at St. Clair Flats, and Dr. Wheaton notes it from Ohio. It prefers to migrate along the Atlantic coast.

53. GENUS TOTANUS BECHSTEIN.

a¹. Middle toe not more than half as long as tarsus; legs yellow.

Subgenus *GLOTTIS* Koch.

b¹. Wing over 7.00.

T. melanoleucus (Gmel.). 102

b². Wing under 7.00.

T. flavipes (Gmel.). 103

a². Middle toe nearly or quite as long as tarsus; legs not yellow.

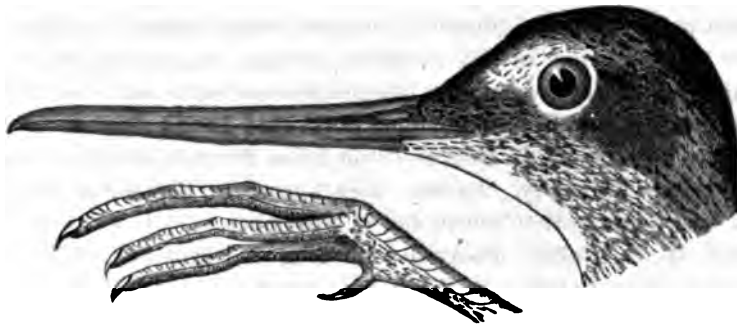
Subgenus *HELODROMAS* Kaup.

T. solitarius (Wils.). 104

Subgenus *GLOTTIS* Koch.

102. (254). *Totanus melanoleucus* (Gmel.).

Greater Yellow-legs.



Head and foot of Greater Yellow-legs. Natural size.

Bill, straight or slightly bent upwards, very slender, grooved half its length or less, black; legs, long and slender, yellow; in summer, ashy-brown: above, varied with black and speckled with whitish; below, white; jugulum, streaked; breast, sides and crissum, speckled or barred with blackish, these latter marks fewer or wanting in winter and in young; upper tail coverts, white, with dark bars; tail feathers, marbled or barred with ashy or white; quills, blackish; large.

Length, about 14.00; wing, 7.50-7.75; bill, 2.20-2.30; tarsus, 2.50-2.75.

RANGE.—America in general, breeding from Iowa and possibly northern Illinois northward, south to Patagonia. Winters from Gulf coast southward.

Nest, a depression in ground, lined with grass. Eggs, 3-4; brownish-buffy, irregularly spotted with rich vandyke or marbled brown; 1.43 by 1.20.

Migrant, tolerably common in suitable places, northward, but rare in the southern half of the State. They arrive about March 20 to

April 15; are most numerous in April; some are seen in May and occasionally in June. Perhaps a rare summer resident in the northern part of the State. It was first observed in Vigo County, where it has been taken earliest in spring—March 19, 1887 (Evermann); March 27, 1888 (Blatchley), and March 20, 1896 (Kendrick). At Brookville its earliest spring record is March 26, 1887, while in 1883 it was not noted until April 7. Mr. J. G. Parker has observed it at Liverpool, Ind., March 30, 1895, though he reports it as early as March 20 from Cook County, Illinois. In 1883 it was last noted at Brookville May 6, but in 1884 it was seen May 16. In 1896 it was last seen at Laporte May 6 (Barber), and in 1888 they were reported from English Lake June 3 (Deane).

In the southern half of the State it is more often reported in spring, when it frequents the edges of ponds and water courses, marshes and wet meadows, but in the northern portion, among the lakes and marshes, it is more common in late summer and early fall. Mr. Parker has observed it to be most common northward during August. It was observed by Mr. C. L. Cass at Clear Lake, Steuben County, August 23, 1894. Generally, however, they appear in September, passing southward late in that month and in November.

Mr. W. O. Wallace observed a number, and shot two, in Wabash County, along the Wabash River, September 24, 1893. Messrs. L. A. and C. D. Test noted it at Lafayette last, October 21, 1895. In Illinois, in June, 1875, Mr. E. W. Nelson found several of these birds about the Calumet marshes, where, from their actions, he was certain they were breeding, but did not find their nests. The 10th of June, 1876, Mr. Rice observed a pair about a prairie slough near Evanston; a few days later a set of eggs was brought to him, which from the description of the bird, which was driven from the nest, both he and Mr. Nelson decided must belong to this bird. "The nest was situated in a slight depression at the base of a small hillock at the border of a prairie slough, and was composed of grass and blades. The eggs measure, respectively 1.70 by 1.30, 1.72 by 1.31, 1.74 by 1.32, 1.80 by 1.38 inches. The ground color is a deep grayish-white, marked on three eggs with spots of dark brown and on the other egg with spots and well-defined blotches of a considerably lighter shade of the same. In addition there are shell markings and obscure spots of lilac. The markings are disposed quite abundantly over the surface of the egg, but are more numerous about the larger end" (Birds of Northeastern Illinois, pp. 128, 129). Both Mr. Meyer and Mr. Tallman have been unable to determine its nesting at the present time, either in Cook County, Illinois, or Lake County, Indiana.

103. (255). *Totanus flavipes* (GMEL.).*Yellow-legs.**

A miniature of the last; colors, precisely the same; legs, comparatively longer; bill, grooved rather farther. May always be distinguished by its smaller size.

Length, 10.50-11.00; wing, 5.50-6.50; bill, 1.30-1.55; tarsus, 2.00.

RANGE.—America, from Patagonia to the Arctic Ocean. Breeds principally in the interior from northern Illinois and Minnesota northward. Winters from Gulf coast southward.

Nest, a hollow in ground, lined with grass. *Eggs*, 3-4; color, variable, usually buffy, spotted or blotched with dark madder or vandyke brown and purplish-gray; 1.69 by 1.15.

Common migrant; much more numerous in the northern part of the State, where some are summer residents and breed. More common in the fall, when they are often found associated with other kinds of Sandpipers on mud flats and shores. In the spring they sometimes begin to arrive by April 1, and the latter part of the month, they have left the greater part of the State, though in the northern part they sometimes are found well towards the middle of May.

The earliest arrivals in spring were in 1895. That year Mr. Parker took one at Liverpool, Ind., March 30, and Mr. Earle, one, April 1, at Greencastle. The last report from southern Indiana that spring was from Bloomington, where it was noted April 26 (Juday). In the White-water Valley its earliest arrival at Brookville is April 7 (1883) and the latest first arrival April 17 (1884 and 1896). In 1896 it was last seen at Laporte May 8 (Barber). In 1890 flocks were seen at English Lake May 4 and 11, and in 1891, on May 10, several large flocks were noted. There was quite a flight all day (Deane). Mr. L. T. Meyer tells me he found its nest and obtained a set of four eggs in the Calumet marsh, Lake County, in 1885.

In 1893 they appeared there on the return migration, the earliest I have ever known them. That year was very dry, and the continued drouth had almost exhausted the water in Mud Lake, Ill., and left its soft bottom an exposed mud flat. This, which had been a favorite feeding ground in fall, was unusually attractive to them that year. Perhaps the dry weather extended far enough north to influence the shore birds in their early movement. Mr. J. O. Dunn found them July 3, 1893, at Mud Lake in a flock, and shot two. One that he shot from a flock of Least Sandpipers had one foot off. He notes that a good portion of the Sandpipers shot had legs and toes missing. On August 2, while wading on the flat, a Yellow-legs alighted and began

to feed within twenty feet of him. It was shot and found to be in very poor condition and in winter plumage. Mr. Parker also found them very abundant at Mud Lake July 25, 1893.

These birds and the last species usually are quite watchful. They associate with other smaller waders, and when their sharp eyes discern danger, their loud cries warn the company, which seek safety in flight. For this habit they have been called by shooters, "Tattlers" and "Telltales," by which names they are generally known. In 1894 Mr. Dunn found them common at Bass Lake, Starke County, Indiana, from July 28 to August 6, and in 1896 Mr. C. A. Tallman saw two in Cook County, Illinois, July 24.

Mr. C. Grave found them on the Kankakee River August 8, 1892. August 1 to 15, 1889, they were very common in all the marshes about Chicago (Parker).

Throughout August they continue arriving at these attractive grounds in northern Indiana. September 1, 1889, they were very abundant at Water Valley. Very large flocks were seen all day (Deane). In September they are observed farther south. By the 10th of that month most of them have left the northern part of the State, while some linger on their journey southward well towards the end of the month. Hillsdale, Mich., September 29, 1894 (Cass); Brookville, Ind., September 21, 1885.

Subgenus HELODROMAS (Kaup).

***104. (256). *Totanus solitarius* (WILS.).**

Solitary Sandpiper.

Bill, perfectly straight, very slender, grooved little beyond its middle; dark lustrous olive-brown tinged with greenish, streaked on the head and neck; elsewhere finely speckled with whitish; jugulum, and sides of neck, with brownish suffusion and dusky streaks; rump and upper tail coverts, like the back; tail, axillars and lining of wings, beautifully barred with black and white; quills, entirely blackish; bill and feet, very dark olive-green.

Length, 7.50-8.60; wing, 5.00-5.40; bill, 1.15-1.30; tarsus, 1.25-1.90.

RANGE.—America, from Brazil north to Alaska. Breeds from Indiana, Ohio and Vermont northward. Winters south of United States.

Nest, see notes on nest and eggs below.

Common migrant; summer resident in some numbers northward. Breeds. This bird is solitary in its habits. It is usually found alone,

by some creek or ditch or secluded river bar, or on the edge of a pond, or woodland pool. At times they, also, are found in small flocks.

This is one of the most unsatisfactory birds upon which to work. Both as regards its migrations and its breeding, much information is desired. At Brookville I have never found it earlier than April 21, yet I have reports of its occurrence as early as March 17 and of its being common by March 30. Probably these are incorrect identifications.

In the vicinity of Lake Michigan they have been first noted April 22 (1896) to May 10 (1894). They pass northward through May. Last seen: At Brookville, 1890, May 17; 1889, May 8; 1886, May 6; English Lake, 1890, May 11; 1891, May 10; very abundant everywhere, mostly in pairs (Deane).

Throughout the northern part of the State some are summer residents, and breed. Possibly a few do southward, also. Information regarding the breeding of this bird is greatly desired, and among the special desiderata are its eggs. Many times eggs purporting to belong to this species have been found, but satisfactory evidence of their identity has been lacking.

The late Dr. J. M. Wheaton describes an egg taken by Mr. Oliver Davie in an open field bordering the Scioto River near Columbus, O. The nest was on the ground in an exposed locality, and contained two eggs well advanced in incubation, only one of which was preserved, and it was deposited with the Smithsonian Institution. He says that this egg, "though without any positive claims, possesses characters which entitle it to consideration as possibly that of this species. It is of a pointed, oval shape, and not nearly so pyriform as are the eggs of most of this family, and measures 1.25 by .88, so that it is smaller than the eggs of the Spotted Sandpiper. The ground color is clay-color with a reddish tinge, thickly marked with reddish and blackish brown" (Birds of Ohio, p. 486). Dr. Brewer (in Bull. Nuttall Orn. Club, Vol III, 1878, p. 197) gave an account of an egg taken by Mr. Jenness Richardson at Lake Bomaseen, Vt., May 28, 1878, which was taken with the bird, which was on her nest, a small depression in the ground, when found. This egg was a light drab, with rounded, brown markings, some quite small and dark, nowhere confluent; at larger end a few faint purplish shell marks; 1.37 by .95.

Mr. Ridgway, in Birds of Illinois, II, p. 63, says "its eggs have never yet, so far as is known to the writer, been taken." It is not improbable that this species, like its European relative, the Green Sandpiper (*T. ochropus*), deposits its eggs in deserted nests of other birds, such as the Wood Thrush and other species which nest in moist wood-

lands. It seems probable, from the fact that adults have been found accompanied by two young, that the number of eggs is two.

Mrs. Jane L. Hine, Sedan, Dekalb County, informs me it breeds in that county, and she has seen young birds July 15. Mr. W. O. Wallace writes me he caught two young which were unable to fly, on the border of a small pond in Wabash County, in the summer of 1892. Mr. H. W. McBride says it nests in Elkhart, and Mr. A. H. Kendrick, in Vigo County. They begin to move southward in August, and pass slowly through that month and all of September. I noted them at Brookville August 13, 1881. Mr. Parker observed it at Mud Lake, Illinois, September 19, 1894. Mr. V. H. Barnett found it in Brown County October 5, 1897; Brookville, September 25, 1884. These are the latest records I have for Indiana. The following interesting notes by Dr. Elliot Coues are from *Birds of Northwest*, p. 500:

"These Tattlers indulge on all occasions a propensity for nodding, like Lord Burleigh or the Chinese mandarins in front of tea shops; and when they see something they cannot quite make out, seem to reason with themselves, and finally come to a conclusion in this way—impressing themselves heavily with a sense of their own logic. They go through the bowing exercise with a gravity that may quite upset that of a disinterested spectator, and yet through the performance, so ludicrous in itself, contrive to preserve something of the passive sedateness that marks all their movements.

"This bobbing of the head and fore parts is the correspondent and counterpart of the still more curious actions of the Spotted Tattlers, or 'Tip-ups,' as they are aptly called from this circumstance; a queer balancing of the body upon the legs constituting an amusement of which these last-named birds are extremely fond. As often as the 'Tip-up' or 'Teeter-tail,' as it is also called, stops in its pursuit of insects, the fore part of the body is lowered a little, the head drawn in, the legs slightly bent, whilst the hinder parts and the tail are alternately hoisted with a peculiar jerk, and drawn down again, with the regularity of clock-work. The movement is more conspicuous in the upward than in the downward part of the performance; as if the tail were spring-hinged, in constant danger of flying up, and needing constant presence of mind to keep it down. It is amusing to see an old male in the breeding season busy with this operation. Upon some rock jutting out of the water he stands, swelling with amorous pride and self-sufficiency, puffing out his plumage until he looks twice as big as natural, facing about on his narrow pedestal, and bowing with his hinder parts to all points of the compass. A sensitive and fastidious person might see something derisive, if not actually in-

sulting, in this, and feel as Crusoe may be presumed to have felt when the savages who attacked his ship in canoes showed the signs of contumacious scorn that De Foe records. But it would not be worth while to feel offended, since this is only the entirely original and peculiar way the Tip-up has of conducting his courtships. Ornithologists are not agreed upon the useful purpose subserved in this way, and have yet failed to account for the extraordinary performance. The Solitary Tattlers, that we have lost sight of for a moment, are fond of standing motionless in the water, when they have satisfied their hunger, or of wading about, up to their bellies, with slow, measured steps. If startled at such times, they rise easily and lightly on wing, fly rather slowly a little distance, with dangling legs and outstretched neck, to soon realight and look about with a dazed expression. Just as their feet touch the ground, the long, pointed wings are lifted till their tips nearly meet above, and are then deliberately folded."

The Eskimo Curlews and some other birds have the same habit.

The Tattlers are unusually silent birds, but when suddenly alarmed they utter a low and rather pleasing whistle as they fly off, or even without moving.

54. GENUS SYMPHEMIA RAFINESQUE.

a¹. Wing 8.00.

S. semipalmata (Gmel.). 105

a². Wing 8.50.

S. semipalmata inornata Brewst. 106

105. (258). *Symphemia semipalmata* (Gmel.).

Willett.

Synonym, SEMIPALMATED TATTLER.

Adult in Summer.—Bill, straight, comparatively stout, grooved little, if any, more than half its length; brownish-olive above, with numerous black marks; white, below; the jugulum, streaked; the breast, sides and crissum, barred or with arrow-shaped marks of dusky; middle tail feathers, ashy, barred with blackish, side ones, whitish, variegated with grayish. *Winter*.—Above, plain ashy-gray; beneath, dull white, unspotted; foreneck shaded with grayish; tail not barred; upper tail coverts, most of the secondaries and basal half of primaries, white; spread wing, with conspicuous white patch; ends of primaries, their coverts, lining of wings and axillars, black; bill, bluish or dark; toes, with two conspicuous basal webs. *Immature*.—Above, brownish-gray, feathers margined and sides tinged with ochraceous.

Length, 15.00; wing, 8.00; tarsus, 2.30; bill, 2.20.

RANGE.—America, from Brazil northward to Canada and Maine. Breeds from Louisiana (where it is resident) northward. Winters on Gulf coast and southward.

Nest, slight hollow in ground, of grass. *Eggs*, 3-4; variable, clay-color to olive-brown, with spots of dark brown and purple; 2.13 by 1.53.

Rare migrant; possibly rare summer resident. I have been unable to determine the standing of this form in the State.

That the eastern form is found, seems probable and since the records of the past have reported this form, there is no way of separating them. It is of irregular and rare occurrence in April, May, August and September. It has been reported from the following counties: Franklin; Decatur (Guthrie); Allen (Stockbridge); Dekalb (Mrs. Hine); Putnam (Clearwaters); Lake, (Aiken). Their call is well known to those who visit places it frequents, and may be represented by the words *pil-willet, it-pil-willet*. The following measurements were given by Mr. Brewster in "The Auk," 1887, p. 146. Average, wing, 7.36; tail, 2.91; tarsus, 2.29; culmen, from feathers, 2.19. Extremes, wing, 7.06-7.75; tail, 2.71-3.30; tarsus, 2.08-2.42; culmen, from feathers, 2.02-2.31.

106. (258a). *Symphemia semipalmata inornata* BREWST.

Western Willet.

Similar to last, but slightly larger, the upper parts are paler, grayish-drab, and not so conspicuously marked with black; breast, more buffy, less streaked and no blackish bars on middle tail feathers. In winter only to be distinguished by the difference in size, which is not always satisfactory.

Wing, 8.50; tarsus, 2.60; bill, 2.45.

RANGE.—Western North America, east to Mississippi Valley and Gulf States; in winter, south to Mexico, and, during migrations, sparingly along coast of southern Atlantic States. Breeds from coast of Texas to Manitoba.

Nest, a depression on ground or on tussock of grass, of grass and weeds. *Eggs*, 3-4; not appreciably different from those of last.

Rare migrant; possibly rare summer resident. Owing to lack of material it is impossible to say to what extent it is found in Indiana. Mr. F. M. Woodruff obtained five from a flock of thirteen at Miller's. Ind., August 14, 1897. I have a specimen in my collection that was shot by Mr. Geo. M. Shirk from the top of a barn in Franklin County the fall of 1878. This would indicate that it is to be found throughout

the State. The following measurements are given by Mr. Brewster from "The Auk," 1887, p. 146. Average: wing, 8.11; tail, 3.29; tarsus, 2.66; culmen, from feathers, 2.46. Extremes: wing, 7.88-8.26; tail, 3.10-3.50; tarsus, 2.45-2.95; culmen, from feathers, 2.28-2.70.

55. GENUS *BARTRAMIA* LESSON.*107. (261). *Bartramia longicauda* (BECHST.).*Bartramian Sandpiper.*

Synonyms, BARTRAM'S TATTLER, PRAIRIE PLOVER, FIELD PLOVER, UPLAND PLOVER, PRAIRIE SNIPE.

Above, blackish, with a slight greenish reflection, variegated with tawny and whitish; below, pale tawny of varying shade, bleaching on throat and belly; jugulum, with streaks; breast and sides, with arrow-heads and bars of blackish; axillars and lining of wings, pure white, black barred; quills, blackish; inner web of outer primary barred with white; tail, varied with tawny, black and white, chiefly in bars; bill and legs, pale, former black-tipped.

Length, 11.00-12.75; wing, 6.50-7.00; bill, 1.10-1.15; tarsus, 1.90-2.05.

RANGE.—America, from Brazil and Peru northward to Alaska and Nova Scotia. Breeds from southern Indiana and Kansas northward. Winters in Mexico and West Indies southward. Accidental in Europe and Australia.

Nest, on ground, in depression. Eggs, 4; creamy buff or white, marked all over with small spots of umber or reddish brown, most numerous at larger end; 1.79 by 1.30.

Migrant and summer resident. Over the greater part of southern Indiana it is only known as a very rare migrant. However, throughout the lower Wabash Valley, in some locations, at least, and to the northward of that river, when it turns toward the east, it is a summer resident in some numbers, and toward Lake Michigan it is common. It apparently breeds over the original prairie region of the State. Mr. Ridgway reported it breeding in Knox and Gibson counties, and in the former county Mr. Chansler informs me he has found both eggs and young in corn fields, after the corn was planted. Mr. Dury reports it breeding in several places in northern Indiana, and Mr. Aiken says it breeds commonly in Lake County, where also Mr. H. K. Coale found young able to run July 4, 1881. Mr. L. T. Meyer took a set of four eggs in the Calumet marsh, in Lake County in May.

In southeastern Indiana it is exceedingly rare. The only record of its occurrence is that given by Dr. Haymond (Rep. Ind. Geol. Surv., 1869, p. 231).

Generally they arrive about the middle of April, but Mr. A. H. Kendrick reports a flock of twenty, from Vigo County, March 19, 1896. Usually they become common at once. During the migrations they are very shy. After a time they become more approachable and during the breeding season seem to have no fear, exposing themselves freely to lead the intruder from the vicinity of their nesting grounds. The nests are often made in meadows and fields bordering a marsh. When in close proximity to the nest the bird has many tricks with which to attract the attention of the unwelcome guest. She is crippled so badly that she cannot walk; she cannot fly; she flops along the ground, and sometimes rolls over. One can easily catch her. If it is his first experience, he will try. Each time, as he attempts to seize her, she seems to have a sudden gift of strength by reason of which she eludes his grasp. After a few ineffectual efforts, one is surprised how recovered the bird is, how her strength is restored, and with it soundness of limb, for she leaves the wondering pursuer and flies away. He is now quite a distance from where the bird was first seen. That is what was wanted. She has accomplished her purpose. She has led him away from her nest.

In the fall, the prairie farmer, as he goes to breaking for wheat, and the chicken shooter is familiar with these birds along the dead furrows and smaller drains, but they always arise beyond gun range.

They leave late in August or early in September. August 27 to September 15.

56. GENUS TRYNGITES CAHANIS.

108. (262). Tryngites subruficollis (VIEILL.).

Buff-breasted Sandpiper.

Quills, largely white on the inner web, and with beautiful black marbling or mottling, best seen from below; tail, unbarred, gray, the central feathers darker, all with subterminal black edging and white tips; crown and upper parts blackish, the feathers; with whitish or tawny edging, especially on the wings; sides of the head, neck all around, and under parts, pale rufous or fawn color, speckled on the neck and breast with dusky; bill, black; feet, greenish-yellow. (McIlwraith).

Length, 7.00-8.90; wing, 5.10-5.50; bill, .75-.80; tarsus, 1.15-1.30.

RANGE.—America, from Uruguay north to Arctic coast. Breeds from southern Ontario northward in the interior to Yukon and Anderson River. Winters south of the United States.

Nest, on ground, lined with moss and grass. **Eggs,** 3-4; buffy grayish-white, varying to pale olive buff, boldly spotted, longitudinally (and somewhat spirally) dark vandyke or madder-brown and purplish-gray.

Rare migrant. Thus far has only been reported from this region in August and September. Usually appears singly or in small flocks, but sometimes in large flocks. Dr. A. K. Fisher shot numbers of them in August, 1874, from a dry prairie at Maywood, Cook County, Ill., only ten miles from Chicago, where there were hundreds of them. (Cooke Rept. Bird Mig. Miss. Valley, p. 97).

The only time it has been taken in this State was September 10, 1892, when L. A. and C. D. Test took one from a shallow pond about four miles northwest of Lafayette. Mr. J. G. Parker, Jr., collected two specimens on the shore of Calumet Lake, Cook County, Ill., in September, 1887. There are two records for Michigan in September and one for Ohio (Cleveland), in August.

Mr. McIlwraith records its breeding in Ontario a few miles from Lake Erie (Birds of Ont., 1894, pp. 156, 157), and Dr. Hatch mentions it as a summer resident of northern Minnesota. (Birds of Minn., p. 143).

57. GENUS *ACTITIS* ILLIGER.

***109. (263). *Actitis macularia* (LINN.).**

Spotted Sandpiper.

Synonyms, PEET-WEET, SANDPIPER.

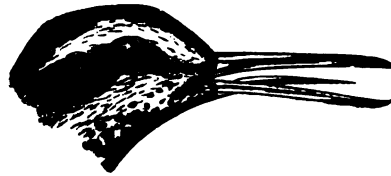
Above, olive, with a greenish lustre, finely varied with black; line over eye, and entire under parts, pure white, with numerous sharp circular black spots; entirely wanting in young birds; secondaries, broadly white-tipped, and inner primaries with a white spot, most of the tail feathers like the back, with subterminal black bar and a white tip; bill, pale yellow, tipped with black; feet, flesh-color. **Immature.**—Similar; above, more buffy; under parts, white, unspotted; slight grayish tinge on breast.

Length, about 7.00-8.00; wing, 4.05-4.60; bill, .90-1.05; tarsus, .90-1.05.

RANGE.—America, from Brazil northward to Hudson Bay and Yukon. Breeds nearly throughout North American range. Winters on coast of Gulf States.

Nest, a depression in ground lined with grass, leaves and weeds. *Eggs*, 4; light buff or white, spotted with blackish-brown; 1.34 by .92.

Common summer resident; a well-known frequenter of the banks of streams, ponds and lakes, and of sandbars everywhere throughout the State. This and the Solitary Sandpiper have the habit of bowing the heads and tilting the rear parts as though they were continually trying to balance themselves. They are known under many common names, such as "Sandsnipe," "Tip-up," "Sandpiper," but the best name I have heard that is applicable to both is an old farmer's appellation "Teeter-snipe."



Head of Spotted Sandpiper. Natural size.

This species is much more noisy than the Solitary Sandpiper, and from its note is often called by what it seems to say: "Peet-weet." On the whole these birds are more numerous and more conspicuous than the Solitary. They usually arrive about the middle of April. Some years it is, however, reported in March, although I have never found it that early in the Whitewater Valley.

It has been reported as first seen in the years named as follows: DeKalb County, 1897, March 18 (Feagler); Vigo County, 1897, March 20; 1896, March 21 (Kendrick); Decatur, 1896, March 28 (Shannon); DeKalb County, 1895, April 4 (Mrs. Hine). The following dates give the records of its appearance at Brookville, Ind., for a number of years past: April 19, 1881; April 14, 1883; April 21, 1885; April 22, 1886; April 15, 1887; April 13, 1888; April 21, 1889; April 25, 1892; April 20, 1893; April 22, 1896; April 22, 1897.

I have observed them mating as soon as they arrive, some years by April 15. I have found them building their nests April 27, and the complement of eggs May 12. I also have found young, but recently, out of the nest as late as July 8. The nests are usually made away from the water, on high ground and among the grass. A railroad or other embankment is a favorite place. The eggs, like those of all the waders, lie with their pointed ends together.

They generally leave the first half of September, occasionally remain into October. The last reported: Warren County, September

26, 1897 (V. H. Barnett); 1892, Liverpool, September 3 (Parker); 1894, Greensburg, September 9 (Shannon); 1895, Cook County, Ill., September 7 (Blackwelder); Lafayette, Ind., October 5 (L. A. and C. D. Test).

58. GENUS NUMENIUS BRISSON.

α^1 . Bill over 3.00.

b^1 . Bill under 4.50.

b^2 . Bill over 4.50.

α^2 . Bill under 3.00.

N. hudsonicus Lath. 111

N. longirostris Wils. 110

N. borealis (Forst.). 112

110. (264). *Numenius longirostris* (Wils.).

Long-billed Curlew.

Synonym, SICKLE BILL.



Long-billed Curlew.

Bill, of extreme length and curvature, measuring from 5.00-8.00 or 9.00 inches; total length, about 2 feet; wing, 10.00-12.00 inches; tail, 4.00; tarsus, 2.25-3.50 (inches). Plumage, very similar to that of Godwit, prevailing tone rufous, of varying intensity in different parts of the same bird, usually more intense under the wing than elsewhere; below, the jugulum, streaked, and the breast and sides with arrow-heads and bars of dusky; above, variegated with black, especially on the crown, back and wings; tail, barred throughout with black and rufous; no pure white anywhere; secondaries, rufous; primaries, blackish and rufous; bill, black, the under mandible, flesh colored for some distance; legs, dark.

RANGE.—Guatemala and West Indies northward to New England and Manitoba. Breeds from Gulf coast, where it is resident, northward. Winters from the Carolinas southward.

Nest, a hollow in ground, lined with a little grass. Eggs, 3-4; clay color; olive and buffy, spotted or blotched with sepia, umber or chocolate: 2.60 by 1.85.

Rare migrant. Formerly more numerous and perhaps occasionally breeding in the northern part of the State.

It winters in the Southern States and is occasionally found in winter in southern Illinois (Cooke, Bird Mig. Miss. Valley, pp. 97, 98).

The spring migration occurs in April and May, while that in the fall begins in August and continues as late as October 13.

I saw a specimen in the possession of Mr. F. M. Noe, Indianapolis, which he said was killed by Herman Eckert, April 2, 1896, in a swamp near Jasper, Dubois County. Mr. F. M. Woodruff records a specimen in his collection from Liverpool, Ind., (The Auk, April, 1896, p. 181). Mr. C. E. Newlin informs me there is a specimen in the Frankfort High School that was taken in Clinton County. It has been reported from the following counties, also: Franklin (Dr. Haymond, Ind., Geol. 1869, p. 231); Knox and White, specimens in collection, Cuvier Club, Cincinnati, Ohio (Dury); Decatur, May, 1883 (Guthrie); Allen (Stockbridge).

This Curlew is very rare in Michigan (Cook, Birds of Mich., p. 63). There are but a few records of its occurrence in Ohio, (Wheaton Birds of Ohio, p. 492), and in Illinois it is now rare, though it was formerly abundant and Nelson reported it nesting in the Calumet marshes in the spring of 1873 (Ridgway Birds of Illinois, II, p. 71).

111. (265). *Numenius hudsonicus* LATH.

Hudsonian Curlew.

Bill, medium, 3.00 or 4.00 inches long; length, 16.00-18.00; wing, 8.00-10.00; tarsus, 2.25-2.30. Plumage, as in the last species in pattern, but general tone much paler; quills, barred; **axillars, buff, distinctly barred with dusky**; crown, uniform dusky, divided by a buff stripe through the middle.

RANGE.—America, from Patagonia to Alaska and Arctic America. Breeds in Alaska, Anderson River and Barren Lands of the Arctic region. Winters on Gulf coast and southward.

Nest, like that of last species. *Eggs*, 4; pale olive, spotted with dull brown; 2.27 by 1.57.

Rare migrant. Occurs with the preceding (Dr. Brayton). Much rarer than the Long-billed Curlew. Although this species is given as a common migrant in most parts of the Mississippi Valley by Prof. Cooke (Bird Mig. in Miss. Valley, p. 98), I have been unable to ascertain where it has been found commonly during migrations.

Dr. Coues (Birds N. W., p. 510) considers it much less abundant everywhere in the United States than either of the other species. Mr. McIlwraith says of it in Ontario, it is most frequently observed of the three at Hamilton, Ont. One May he was on the beach when there

appeared to be a migratory movement of the Hudsonian Curlews toward the north. "They flew high in regular order, like geese, and showed no inclination to alight till a boy, with a long shot, brought down one, wing broken, from a passing flock. Knowing their habits he quickly tied it to a stake in a moist meadow, and concealing himself close by, had good shooting during the afternoon, for the loud outcry made by his prisoner, brought down every passing flock." (Birds of Ont., 1894, p. 159).

They migrate chiefly along the eastern coast and go very far north to breed. But few remain in Alaska in summer. In the interior they have been found plentifully but they nest in the Barren Grounds of the Arctic regions.

112. (266). *Numenius borealis* (FORST.).

Eskimo Curlew.

Synonyms, DOUGHBIRD, DOEBIRD.

Bill, small, under 3 inches long; length, 12.00-15.00 inches; wing, 8.00-8.50; tarsus, 1.70-1.80; tail, 3.00. Plumage, in tone and pattern almost exactly as in last species, but averaging more rufous, especially under the wings, and primaries, not barred; breast, with transverse V-shaped marking.

RANGE.—America, from Patagonia to the Arctic Ocean, chiefly in the interior of the United States, not on Pacific coast. Breeds within the Arctic Circle. Winters from coast of Gulf States southward.

Nest, similar to that of the last two. Eggs, 3-4; pale olive, greenish, olive, or olive-brownish, distinctly spotted, chiefly at the larger end, with deep or dark brown; 2.04 by 1.43.

Rare migrant. There are specimens in the collection of Cuvier Club, Cincinnati, Ohio, that were taken at Vincennes and Chalmers (Dury).

This is the smallest of the Curlews and is commonly known as "Doughbird," or "Doebird." It is rare on the Atlantic coast, unknown on the Pacific and migrates chiefly through the Mississippi Valley, where it is the most abundant species from the neighborhood of that river to the Rocky Mountains. In Illinois it is a rather common migrant (Ridgway). In Ohio and Michigan it is not common. They pass north in spring through April and early May, and return in the fall in September and October. It has been taken at Kalamazoo, Mich., as late as October 28 (Cook, Birds of Mich., p. 63). Dr. Coues found them very abundant in Labrador in August. They are often found in company with Golden Plover.

"The Curlews associate in flocks of every size, from three to as many thousand, but they generally fly in so loose and straggling a manner, that it is rare to kill more than a half a dozen at a shot. When they wheel, however, in any of their many beautiful evolutions, they close together in a more compact body, and offer a more favorable opportunity to the gunner.

"Their flight is firm, direct, very swift, when necessary, much protracted, and is performed with regular, rapid beats. They never sail except when about to alight, when their wings are much incurved downward, in the manner of most waders. As their feet touch the ground, their long, pointed wings are raised over the back, until the tips almost touch, and then are deliberately folded, much in the manner of the Solitary Sandpiper. (*Rhyacophilus solitarius*). Their note is an often repeated soft, mellow, though clear, whistle, which may be easily imitated. By this means they can readily be decoyed within shot, if the imitation is good and the gunner is careful to keep concealed. The smaller the flock the more easily are they allured, and a single individual rarely fails to turn his course toward the spot whence the sound proceeds. When in very extensive flocks, they have a note which, when uttered by the whole number, I can compare to nothing but the chattering of a flock of Blackbirds. When wounded and taken in hand, they emit a very loud, harsh scream, like that of a common hen, under similar circumstances, which cry they also utter when pursued."

"Their food consists almost entirely of the crowberry (*Empetrum nigrum*), which grows on all the hillsides in astonishing profusion. It is also called the 'bear berry' and 'curlew berry.' It is a small berry, of a deep purple color, almost black, growing upon a procumbent, running kind of heath, the foliage of which has a peculiar moss-like appearance. This is the principal and favorite food, and the whole intestine, the vent, the legs, the bill, throat, and even the plumage, are more or less stained with the deep purple juice. They are also very fond of a small species of snail that adheres to the rock in immense quantities, to procure which they frequent the land-wastes at low tide. Food being so abundant and so easily obtained, they become excessively fat. In this condition they are most delicious eating, being tender, juicy and finely flavored; but as might be expected, they prove a very difficult job for the taxidermist. This species breeds in great numbers in the Anderson River region, usually making up its nest complement by the third week in June." (Coues, Birds N. W., pp. 511, 512).

XX. FAMILY CHARADRIIDÆ. PLOVERS.

- α¹. Plumage above speckled, below black in breeding season. CHARADRIUS. 59
 α². Plumage of upper parts not speckled; neck, with dark rings; toes, always three. ÆGIALITIS. 60

59. GENUS CHARADRIUS LINNÆUS.

- α¹. Hind toe well developed, without claw.

Subgenus SQUATAROLA Cuvier. *C. squatarola* (Linn.). 113

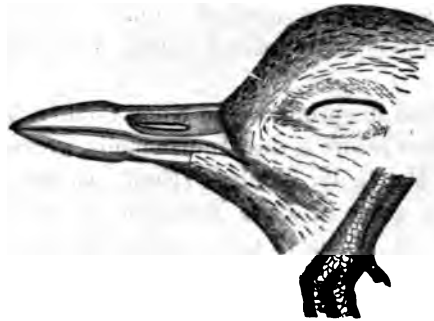
- α². Hind toe absent. Subgenus CHARADRIUS. *C. dominicus* Müll. 114

Subgenus SQUATAROLA Cuvier.

113. (270). *Charadrius squatarola* (LINN.).

Black-bellied Plover.

Synonyms, OX-EYE, BULL-HEAD.



Black-bellied Plover. Natural size.

Adult in Breeding Season.—Barely seen in the United States; face and entire under parts, black; upper parts, variegated with black and white, or ashy; tail, barred with black and white; quills, dusky, with large white patches. *Adults at other times and Immature.*—Below, white, more or less shaded with gray; the throat and breast, more or less speckled with dusky; above, blackish, speckled with white or yellowish; the rump, white, with dark bars; legs, dull bluish. Old birds changing show every grade, from a few isolated feathers on the under parts to numerous large black patches. They may be recognized in any plumage by the small hind toe.

Length, 10.50-12.00; wing, 7.50; culmen, 1.10; tarsus, 1.95.

RANGE.—Nearly cosmopolitan. Breeds in the Arctic regions, and winters from Louisiana and Florida southward. It has been recently shown that the Black-bellied Plover and a number of other birds, including the Knot, Hudsonian Curlew, and Turnstone, which have been credited with spending the breeding season in the Arctic regions,

are abundant residents of the Louisiana coast, but do not breed. It is probable that only those who are prepared for the reproduction of their race make the whole migration. (See article by Mr. E. A. Mchenny. *The Auk*, XIV, 1897, pp. 285-289.)

Nest, a depression in the ground, lined with grass. *Eggs*, 3-4; olive-buff, or brownish-drab, thickly and heavily marked with brownish-black or deep black; 2.04 by 1.43.

Rare migrant, more numerous in the northwestern part of the State. In spring it visits us, going north from April 1st to June 1st, and returns early in August, remaining through October. The spring migration is prolonged throughout the State, but in the fall they seem to remain about Lake Michigan well into September before proceeding southward. Those seen with us are generally solitary birds. Late in May they are seen in pairs. The birds are generally in full breeding plumage. Mr. Nelson says, in northern Illinois, "a few remain during the summer, and undoubtedly breed." (*Bull. Essex Inst.*, Vol. VIII, 1876, p. 122.)

The earliest arrival in spring was in Knox County, March 30, 1888 (Balmer). The latest record is near Indianapolis, where one was killed May 30, 1894, by Mr. C. W. Lambart (Noe). In the fall it has first been noted on the shore of Lake Michigan, at Miller's, August 8, 1897, where Mr. F. M. Woodruff took a fine adult male, and the latest record for that vicinity, is November, 1891, when Mr. J. G. Parker, Jr., observed three at Hyde Lake, Ill. Prof. A. J. Cook reports it from Michigan as late as October 20. The following are additional spring records: Lake County, one killed in 1871 (Aiken), Lebanon; one, May 3; another, May 5, 1894 (Beasley). A pair was taken at Davies' Station, Starke County, May 15, 1884 (Coale). August 24, 1896, Mr. F. M. Woodruff took one on the beach at Miller's. Dury and Freeman obtained a male near Cincinnati, September 21, 1879 (*Jour. Cin. Soc. Nat. Hist.*, July, 1880, p. 104).

The Black-bellied Plover prefers to migrate by way of the sea coast. It has usually been supposed it only bred far north in Arctic lands. In America it has been found breeding on the Arctic coast, east of the Anderson River. Dr. P. L. Hatch has given the first account of its breeding in the United States. He says: "In the summer of 1875 a clutch of four eggs were sent me, with the female, which proved to be a Black-bellied Plover. It was obtained in the vicinity of upper Lake Minnetonka, in my own county. Since then several nests have been reported by persons competent to determine them, and I accept the conclusion that this species breeds to a limited extent in some portions of the State." (*Birds of Minn.*, p. 149.)

Subgenus *CHARADRIUS* Linnaeus.**114. (272). *Charadrius dominicus* MÜLL.****Golden Plover.**

American Golden Plover, Winter Plumage.

Adult in Summer.—Black above, speckled with bright yellow; forehead and a broad line over the eye, white; tail feathers, grayish-brown, with imperfect white or ashy bars; below, black; axillars, gray or ashy. *Winter.*—Above, blackish, speckled with whitish and yellow; under parts, as in last species. The absence of the small hind toe, in a bird of this size, will determine any doubtful specimen.

Length, about 10.50; wing, 6.80-7.20; culmen, .85-.90; tarsus, 1.50-1.65.

RANGE.—America, from Patagonia to Arctic Ocean. Breeds on the coast and islands of Arctic America, except the coast of Bering Sea. Winters from Florida and Louisiana southward.

Nest, a hollow in ground, slightly lined with grass. *Eggs,* 4; varies from pale buffy-brown to dark grayish-buff, spotted and blotched with brownish-black, chiefly at the larger end; 1.90 by 1.30.

Migrant. Formerly very abundant over the original prairie region, but are now seen in greatly reduced numbers, though still common, and to the east and south of that quite rare. They usually migrate in flocks of from 15 to 100. Sometimes there are hundreds and even thousands seen in a flock in spring. They are found upon the meadows, pastures and prairies in spring, and in fall, also, upon stubble and plowed fields. With the occupation of the level land, the extension of commercial enterprises, and the continued warfare upon the game birds by the rapidly increasing population of our counties in north-

western Indiana and of the cities across the border, these birds are being fast destroyed. Mr. J. G. Parker, Jr., says, in 1886, he could go within eight miles of Chicago, in April, and see thousands of them. In 1890 he noted they are now seen chiefly only in small flocks. Mr. Parker saw ten enormous flocks at Liverpool, Ind., April 30, 1895.

Mr. Blackwelder also notes their decrease. In 1897 he says it is still plentiful, though the number is fast decreasing. In 1887 Mr. C. E. Aiken found them plentiful near Crown Point. In 1888 Prof. Evermann reported them common in Vigo County, March 24, having first been seen the day previous. In addition they are reported as common in Clinton County (Ghere), and on the prairies of Carroll County, southwest of Delphi (D. C. Ridgley). On the contrary, Prof. Evermann does not give it in his report of the birds of Carroll County. It has not been reported from the following counties, where more or less good ornithological work has been done: Monroe, Brown, Ripley, Johnson, Marion, Howard, Tippecanoe, indicating it is at least not common there and it is rare throughout the Whitewater Valley, and in the following counties: Boone (Beasley), Putnam (Earlle), Decatur (Shannon), Delaware (Williamson). In addition to the date of first appearance given by Prof. Evermann from Vigo County in 1888, it was first seen at Muncie, March 30, 1888 (Williamson); in Putnam County, 1894, March 28 (Earlle); and in 1897 in Vigo County, March 23 (Kendrick). The earliest record from the vicinity of Lake Michigan is in Cook County, Ill., March 22, 1884 (Parker). In 1896 it was first noted at Greensburg, April 11 (Shannon), and in the vicinity of Chicago April 18, and last seen that spring May 9 (Blackwelder). The latest spring record in Boone County is May 10, 1894 (Beasley). It is also recorded from Cook County, Ill., May 10, 1884 (Parker), and Starke County, Ind., May 6, 1888 (Deane).

In general it may be said a few early birds begin to arrive shortly after the middle of April; the greater number, however, not until near the middle of that month. After a short stay they pass northward, a few lingering into the early part of May. They are just putting on their breeding plumage when they are with us, and are very beautiful in their mottled dress. Their appearance is very irregular. Sometimes they are found in great numbers, and other years few or none are seen. In the Whitewater Valley I have only found a few in April.

They go far north to breed, and there only are found in full breeding plumage. Beyond the Arctic Circle, on the Barren Grounds of British America and the coasts and islands of the Arctic Ocean, they rear their young. Nelson says it is one of the commonest breeding

waders, over the grass and moss-grown country, extending along the shore of Bering Sea. They occasionally lay by June 1. Dall found it common along the Yukon. Nelson says its clear, plaintive call-note may be represented by the syllables *too-lu-e*, and also gives an interpretation of its song. (N. H. Coll., in Alaska, p. 124.)

Mr. J. G. Parker, Jr., says the young return in August ahead of the older birds. He has observed them in Cook County about August 10, 1889. According to migration reports of 1885, they were noted that year at Fernwood, Ill., July 15; next seen, August 3; common, August 20; disappeared, October 12. They vary in abundance through August, September and early October. Some few, however, remain some years well into November. They were last noted as follows in the years indicated: Cook County, Ill., 1883, October 6; 1893, September 19 (Parker); 1895, October 26 (Blackwelder); Boone County, Ind., 1894, September 29 (Beasley); Starke County, English Lake, 1891, a few, November 9; 1892, one, November 15 (Deane). Ordinarily they do not frequent the reedy marshes and swamps, but the long-continued drouth transformed the marshes at English Lake, those years, into "muddy flats," and a few Golden Plover were found on them.

60. GENUS *ÆGIALITIS* BOIK.

- a*¹. Tail half the length of wing or more; rump pale brownish; two black bands on breast. Subgenus *OXYECHUS* Reichenbach. *A. vocifera* (LINN.). 115
- a*². Tail less than half as long as wing; rump same color as back; breast with one band or none. Subgenus *ÆGIALITIS*.
- b*¹. All toes distinctly webbed at base. *A. semipalmata* Bonap. 116
- b*². No web between the base of inner and middle toe.
- c*¹. Black band across breast wholly or partially interrupted in middle. *A. meloda* (Ord). 117
- c*². Black band continuous across breast. *A. meloda circumcincta* Ridgw. 118

Subgenus *OXYECHUS* Reichenbach.

*115. (273). *Ægialitis vocifera* (LINN.).

Killdeer.

SYNONYM, KILLDEER PLOVER.

Adult.—Quaker-brown, with a greenish tinge, sometimes most of the feathers tipped and edged with orange-brown; rump and upper tail coverts, ochraceous; breast, crossed by two black bands; forehead and entire under parts, except as stated, white; bill, black; feet, pale; eyelids, scarlet. *Immature*.—Similar to adult, but feathers of upper parts more or less distinctly margined with pale rusty or ochraceous.

Length, 10.00-11.25; wing, 6.20-6.75; tail, 3.60-4.10; culmen, .70-.90; tarsus, 1.40-1.55.

RANGE.—America, from Columbia and West Indies north to Manitoba and Newfoundland. Breeds throughout its North American range. Winters in southern Illinois and southern Indiana and Virginia southward.

Nest, on ground. *Eggs*, 4; buffy-white, with chocolate markings, principally at the larger end; 1.47 by 1.04.

Common summer resident. Resident in greater or less numbers, some winters, in the southern part of the State. Often, over a good part of the State, they are not absent more than two months. The



Killdeer.

bulk of them spend their winters along the Gulf of Mexico. Everywhere it is the earliest and best known of its family to arrive. In the Whitewater Valley, some winters, it remains; others, it leaves for a few weeks in December. The following give the date it was first seen each year at Brookville: 1881, February 15; 1884, March 12; 1886, March 14; 1887, March 6; 1889, February 16; 1890, February 15; 1893, March 3; 1895, March 22. In Knox County Mr. E. J. Chansler says it is resident, some seasons common, others rare. Some years it is found as early as February over almost the entire State. The following dates of first appearance north of the latitude of Indianapolis are taken from years of early spring migrations: Lafayette, February 26, 1889 (Test); 1894 and 1896 were early years. The former they were noted as follows: Laporte, March 3 (Barber); Sedan, Dekalb County, March 2 (Mrs. Hine); Plymouth, Mich., March 4 (Alexander); Sandusky, O., March 4 (Moseley); Chicago, Ill., March 10 (Dunn). The latter year at the following places: Camden, February 28 (Sterling); North Manchester (Bell), Waterloo (Mrs. Hine).

and Chicago, March 26 (Blackwelder). The earliest record given from Chicago is that by Mr. Dunn, March 10, and the latest of first arrival is April 2, 1885 (Parker). The following are other dates of first arrival there: March 26, 1884 (Parker); March 27, 1897 (Tallman). It is to be observed that the first arrivals in early years are from about one to four weeks later reaching the vicinity of Chicago than they are in reaching the same latitude in eastern Indiana, Michigan or the shore of Lake Erie, and the difference in the date of becoming common is almost as notable. Years when the migration is later they reach these points at approximately the same dates. Doubtless, some years, the early opening of the rivers running southward into the Ohio afford an opportunity for early migrations, while the conditions around the lower end of Lake Michigan are uncongenial. Therefore, by way of the valleys of the Wabash, Whitewater and Miami Rivers, they find their way to the upper Lake Basin, near Lake Erie. Usually they are commonly found throughout the district mentioned by the latter part of March. Their call, "*Killdeer*," from which they take their name, is well known to the people of the State. Beside this, it has a lower call, often uttered as the birds run rapidly ahead of one, in the pasture or stubble, or on the river bar. It is represented by *tê-ê-ê-ê-t*, uttered with a sort of mechanical emphasis. The eggs are laid in a depression on the ground. Four constitute a set, and the small ends are laid together, forming a cross. They lay in pastures, corn fields, on prairies and gravel bars, above the ordinary summer flood. I have taken the full complement of eggs, April 15, and sometimes the young are found in June.

After the young are grown, they and the adults collect into small flocks and the borders of our streams and lakes are enlivened by them. Most of them go south in October, but many remain until November and even December in the northern part of the State.

Subgenus *ÆGIALITIS* Boie.

116. (274). *Ægialitis semipalmata* (BONAP.).

Semipalmated Plover.

Synonyms, RING PLOVER, RING-NECK.

Adult in Summer.—Above, grayish-brown; forehead, ring around neck, and lower parts, white; fore part of crown, lores, and broad pectoral collar (continued around back of neck, below the white nuchal collar), black or dusky; bill, yellow or orange, black-tipped. *In Winter*.—The black markings replaced by grayish-brown, like the back, etc. *Immature*.—Like winter adults, but bill wholly black, and feathers of upper parts margined narrowly with buff. (Ridgway.)

Length, 6.50-7.50; wing, about 4.65-5.00; culmen, .48-.55; tarsus, .95-1.05.

RANGE.—America, from Brazil and Peru north to Arctic coast. Breeds from Labrador and Alaska northward. Winters on coast of Gulf States and southward.

Nest, in depression on ground, lined with grass. *Eggs*, 2-4; white or pale buff, irregularly spotted with chocolate or black; 1.26 by .94.

Migrant, generally rare, not uncommon at times in the vicinity of Lake Michigan. Sometimes found in small flocks, numbering as many as twenty-five. Often seen singly or in pairs in company with Killdeers. In fall, particularly, they, singly or a few in number, are often found associated with Semipalmated and Least Sandpipers. Their habits are much like the Killdeers, and their note is a soft, mellow whistle.

They are present in the spring migrations late in April and through May. Mr. Deane obtained specimens from a flock of about twenty-five on English Lake, May 6, 1888. Those shot were very fat. Mr. Coale obtained two females in Lake County, May 27, 1877. Mr. C. A. Tallman noted them at Wolf Lake May 23, 1896. Mr. Nelson noted it as early as April 25 in northeastern Illinois. He also found adults and young, recently fledged in the vicinity of Chicago, July 2, 1873, and thought possibly they had bred there. Davie says "both eggs and young have been taken near Chicago, Ill., in July." It has been found breeding in Minnesota (Dr. Hatch).

Usually they return in August and remain about suitable places into September. Dry summers the submerged flats and bars and exposed shores of the smaller lakes and streams in northern Indiana are attractive places for them, and at such times they are quite common. The shores of Lake Michigan are also frequented by them at that season.

Mr. J. G. Parker, Jr., notes it as early as July 15. Mr. J. O. Dunn obtained one at Bass Lake, Starke County, August 1, 1894, and found it at Peru October 2, 1893. They sometimes remain until the last of October (Nelson). There is a specimen in the collection of the Indiana State Museum, at Indianapolis, from Jasper County.

In addition, it has been reported from the following counties: Tippecanoe (Dr. E. Test), Putnam (Clearwaters), Allen (Stockbridge), LaPorte (Byrkit). It has never been noted in the Whitewater Valley. Dr. Coues found them breeding abundantly in Labrador. They have also been found breeding on the Arctic coast, near the mouth of the Anderson River and at the mouth of the Yukon in Alaska.

117. (277). *Ægialitis meloda* (ORD).**Piping Plover.**

Adult in Summer.—Above, pale brownish-gray; forehead, lores, nuchal collar, and lower parts, white; a band across fore part of crown, and one on each side of breast, not meeting in front, black or dusky; bill, yellow or orange, black at tip. *In Winter.*—These black markings replaced by light brownish-gray, and the bill almost entirely, or wholly, black. *Immature.*—Like the winter plumage, but feathers of upper surface with distinctly paler terminal margins.

Length, 6.25-7.50; wing, 4.50-4.80; culmen, .45-.50; depth of bill at base, .20-.22; tarsus, .85-1.00.

RANGE.—Eastern North America, from West Indies to Labrador. Breeds from Virginia and southwestern Ontario north. Winters from Carolinas southward.

Eggs, laid on beach, 4; creamy-white, speckled with black and purplish gray; 1.27 by .96.

Rare migrant over most of the State; probably summer resident, with the nest along Lake Michigan. It has been reported by L. A. and C. D. Test, from Lafayette, September 18, 1895, which is the usual time of their departure. Mr. Ruthven Deane obtained both forms of the Piping Plover from the same flock at English Lake, May 17, 1891. This bird is not as often seen with us as the next. I doubt not these two forms will be considered one ere long. The differences do not seem to be such that they should remain separated.

118. (277a). *Ægialitis meloda circumcincta* RIDGW.**Belted Piping Plover.**

Similar to *Æ. meloda*, but with a continuous black band across the breast. Size of last.

RANGE.—Interior of North America. Breeds from northern Indiana, northern Illinois and probably Nebraska north to Lake Winnipeg. Winters along Gulf coast.

Eggs, as in last.

Migrant over most of the State; summer resident in considerable numbers along Lake Michigan. Breeds.

With us this variety and the species last named are found together, the greater number, however, being this form. Mr. Nelson notes their arrival near Chicago the middle of April. Mr. H. K. Coale took one at Tolleston, Lake County, May 1, 1880, and a pair near Whiting, May

25, 1879. In the southern part of the State, Mr. Robert Ridgway saw a pair on a sand-bar in the White River north of Wheatland late in May, 1885. Mr. Deane noted them at English Lake, May 17, 1891. Mr. J. G. Parker, Jr., took specimens August 13, 1894, at Miller's. It has been noted in Indiana May 1, and found continuously until late in August. They are often paired when they arrive and proceed at once to nesting. They continue coming till June; consequently the nesting season is much prolonged.

Some thirty pairs were breeding along the beach within a space of two miles, April 24, 1876, at Waukegan, Ill. They nest on the flat, pebbly beach between the sand-dunes and shore. (Nelson, Birds N. E. Ill., p. 123.) August 1, 1897, Mr. F. M. Woodruff found downy young, also three pairs nesting at Miller's, Ind. This gives a period of over three months from the date given by Mr. Nelson for the breeding season. Either there is an unusual extension of the season or more than one brood is reared in a year. Prof. H. Duemling, of Ft. Wayne, has a specimen in his collection taken near that place (Stock-bridge). They are said to remain until the last of September.

XXI. FAMILY APHRIZIDÆ. SURF BIRDS AND TURNSTONES.

*a*¹. Bill pointed, upturned at end; tarsus not longer than bill. ARENARIA. 61

SUBFAMILY ARENARIINÆ. TURNSTONES.

61. GENUS ARENARIA BRISSON.

119. (283). *Arenaria interpres* (LINN.).

Turnstone.

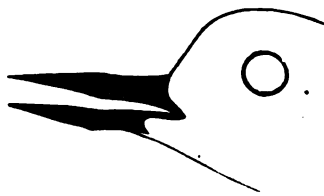
Adult in Summer.—Pied above, with black, white, brown, and chestnut red, the latter color wanting in winter and in young birds; below, from the breast (which is more or less completely black), throat, most of the secondaries, bases of the primaries, and bases and tips of the tail feathers, white; bill, black; feet, orange. *In Winter*.—White parts as in summer, most of other parts dusky or brownish. *Immature*.—Above, brownish-gray, feathers bordered with whitish; upper tail coverts, white; throat, foreneck and breast, white, streaked with dusky; lower parts, white.

Length, 9.00-9.90; wing, 6.00; bill, .80-.90; tarsus, 1.00.

RANGE.—Nearly cosmopolitan. In America, from Patagonia to Greenland and Alaska. Breeds from Hudson Bay to the Arctic coast. Winters from coast of Gulf States southward.

Nest, a hollow in ground, lined with grass. *Eggs*, 2-4; greenish-drab, spotted all over with brown; 1.60 by 1.17.

Rare migrant. Except along Lake Michigan it is almost unknown. There are but two records from the interior of the State. Dr. Haymond observed it in Franklin County (Ind. Geol. Rept. 1869, p. 228). May 20, 1888, Mr. Ruthven Deane observed it in Starke County. Messrs. Eliot Blackwelder and C. A. Tallman identified two Turnstones at Wolf Lake, Ind., May 23, 1896; two were also seen there



Bill of Turnstone.

June 9 of that year. August 8, 1897, Mr. F. M. Woodruff took two in breeding plumage at Miller's, and August 21 took a young male at the same place. Nelson has noted them in Cook County, Ill., about September 20.

They may be said, therefore, to be found in the vicinity of Lake Michigan through the latter half of May and the first third of June, and from early August until about the middle of September. In the fall, at least, they are generally found with flocks of small Sandpipers.

They breed far northward along the coast of the Arctic Ocean and in Alaska. Mr. Geo. B. Sennott found them on the coast of Texas during the breeding season. (Bull. U. S. G. & G. Sur. of Terr.; Vol. V, No. 3, 1879, p. 431).

Mr. E. A. McIlhenny says it is an abundant resident on the coast of Louisiana (The Auk, Vol. XIV, 1897, p. 289). Do those only who are to breed make the long journey beyond the Arctic Circle, or does this bird breed sometimes on our southern coast? Mr. McIlhenny has stated that several other species previously supposed to spend the summer far north are summer residents of the Louisiana coast.

H. ORDER GALLINÆ. GALLINACEOUS BIRDS.

SUBORDER PHASIANI. PHEASANTS, GROUSE, PARTRIDGES, QUAILS.

XXII. FAMILY TETRAONIDÆ. GROUSE, PHEASANTS, ETC.

*a*¹. Wing under 6.00; tarsus bare; sides of toes without comb-like projections.
Subfamily PERDICINÆ.

*b*¹. Head not crested. COLINUS. 62

*a*². Wing over 6.00; upper half or more of tarsus feathered; toes in winter with a fringe of horny points. Subfamily TETRAONINÆ.

*c*¹. Tarsus feathered about half way to toes. BONASA. 63

*c*². Tarsus feathered to toes.

*d*¹. Toes feathered; plumage in winter white. LAGOPUS.

*d*². Toes not feathered.

*e*¹. Neck with tuft of elongated, stiff feathers on each side; tarsus naked behind. TYMPANUCHUS. 64

*e*². Neck without peculiar feathers.

*f*¹. Tail rounded. DENDRAGAPUS.

*f*². Tail pointed; middle feather projecting beyond the others.

PEDICATES.

SUBFAMILY PERDICINÆ. PARTRIDGES.

62. GENUS COLINUS LESSON.

*120. (289). *Colinus virginianus* (LINN.).

Bobwhite.

Synonyms, QUAIL, PARTRIDGE.

Male.—Coronal feathers, erectile, but not forming a true crest; forehead, superciliary line and throat, white, bordered with black; crown, neck all round and upper part of breast, brownish-red; other under parts, tawny-whitish, all with more or fewer doubly crescentic black bars; sides, broadly streaked with brownish-red; upper parts, variegated with chestnut, black, gray and tawny, the latter edging the inner quills. *Female*.—Known by having the throat buff instead of white, less black about the fore parts, and general colors less intense; rather smaller than the male.

Length, 9.50-10.75; wing, 4.30-4.70; tail, 2.40-2.90.

RANGE.—Eastern United States and southern Ontario, west to eastern Minnesota, Nebraska, Kansas, Indian Territory and eastern Texas; south to Georgia, Alabama and other Gulf States.

Nest, on ground. *Eggs*, 10-18; white; 1.19 by .94.

Resident; generally common. Breeds. The Bobwhite is generally known in Indiana as the "Quail." To some it is the "Partridge."

At the beginning of the settlement of this State, when virgin forests composed of trees both large and tall, covered most of the present area, there was not much ground suitable for the "Bobwhite." They were doubtless confined to the bushy river bottoms, old Indian clearings, small prairies, and other partially open spaces. With the advent of the pioneer, the day of their extension was at hand. They followed in the path of his axe, and occupied the neighborhood of clearings. They accompanied him as he planted, where he had overthrown the ancient growth. As civilization spread, they followed. Their enemies being few, they thrived. Their numbers increased, and they grew very tame. The pioneer did not hunt them, as they are hunted now. One was occasionally killed with a rifle, but the trap



Bobwhite, male and female, natural size.

was the principal means of taking them. Nevertheless they became very abundant, and were found throughout our State. But shotguns, first muzzle, then breech-loaders, came to war against them, and the trained dog was brought to assist. Enemies in furry coats—foxes, skunks, minks, weasles, cats—either because of the destruction of other foods or because they were so abundant and so tame, made war upon them.

Enemies in scales—snakes—found their nests upon the ground a convenient source of food supply. The open meadows and clear fields afforded opportunities for swift-moving hawks and prairie owls to live there as they could not in the days of the forest, and Bobwhite suffered, as did the other farm birds. To the pot-hunter more than

any other one cause, except the severe winters, we may charge the destruction of these beautiful birds. In the more thickly settled portions of the State, in the neighborhood of large cities, and in the vicinity of Chicago, where boys with firearms and target guns range the country, and at certain seasons of the year men take up the custom, shooting at all sorts of birds, killing many and scaring the others away, Bobwhites and all other game birds can scarcely be seen. Mr. Parker informs me it is very rare in Cook County, Ill., and Mr. L. T. Meyer said, in 1886, in Lake County, Ind., they were rapidly becoming extinct. In both these counties they were formerly very common. Mr. Meyer speaks of them being so tame, they formerly came about the farm buildings and roosted with the chickens. A succession of hard winters or one of unusual severity sometimes reduces their numbers very low. The winter of 1878-79 they were almost exterminated by reason of the severe weather and their inability to procure food. In the spring whole covies were found dead where they had huddled together and frozen. Few were found for several years thereafter. They were slow to recover from the effects of that winter. From 1884-5, Prof. Evermann says they were rare in Carroll County, where they were formerly abundant. During the winter of those years he estimates that he did not see 100 quail in the county. (*The Auk*, October, 1888, p. 349.) The years 1890-91 they were more numerous, in southern Indiana, at least, and I doubt not throughout the State, than they had been prior to the winter of 1878-9. The year 1892 and the succeeding winter, over the northern two-thirds of the State, at least, was very unfavorable to them. The spring and early summer of that year, the more level and little-drained land of northern Indiana was to a greater or less extent submerged, and their nests were washed away and their eggs spoiled by water and, many places, they were prevented from nesting. June 17, 1892, Mr. Ruthven Deane wrote me the Kankakee region had then been practically under water for two months, and that it had been a hard season on quail. He thought the majority of their nests had been destroyed. The winter following this was quite severe, and throughout northern Indiana there was much snow, the ground remaining covered a long time. From wherever I have reports, the destruction of Bobwhite is noted. Mr. M. W. Salmon, of Kilmore, Clinton County, says "the few quails that survived the deep snow and cold of January (1893) were weak and became a prey to Hawks, etc. They were almost annihilated. Of this Ulrey and Wallace have also spoken (*Proc. I. A. S.*, 1895, p. 69).

About the middle of October I have noticed the Bobwhites of southern Indiana begin to change their habits. From the cheerful, matter-

of-fact bird about the farm, they become erratic. Hunters say they are crazy. They seem possessed with a desire to migrate, coming into towns and cities in some numbers. They, at such times, are lost and bewildered. They are found in trees and among the shrubbery of gardens, in outbuildings and among lumber piles. I have seen them in the cellar window-boxes and over the transoms of the front doors of houses. They fly into stores and dash against their glass fronts. Throughout the day their characteristic call is heard, each one calling to its mate who-e-he, who-e-he, which we sometimes interpret as "Where are you?" "Where are you?" I have noticed this as early as October 12 (1890). Some years it is much more noticeable than others. On the farms the results of this movement are seen. Farms where a number of covies have been reared will be found to have no Bobwhites on them by November 1. Other farms, not far away, will have the number of these birds greatly increased.

Some years they appear to desert the uplands and seek the river valleys. The fall of 1890 hunters spoke of the scarcity of Bobwhites when the season opened. The uplands, which are first hunted, were found to contain almost no birds, although a few weeks before they were abundant there. They were, however, abundant in the river valleys, where, among the bottom corn-fields, they were not hunted till later. Most of them apparently attempted to migrate southward.

The Ohio River bottoms contained immense numbers of Bobwhites, and many crossed the river into Kentucky, others were killed in attempting to cross. I have been told that when they reached Kentucky they were exhausted and many of them were killed without the use of a gun, or were trapped without much effort.

By spring the flocks have generally been scattered. However, in protected localities, they frequently remain together quite late, much later than some begin mating. A flock of fourteen was observed dusting themselves in the sand, April 27, 1897.

The spring call of this bird is what has given it the present name. "Bob-white, Oh! Bob-white" sounds from many a stake of the old worm fence, in May and June. No more cheery sound is heard throughout rural America than this call at mating time. It has been fittingly set in a beautiful poem by the master hand of my friend, Lee O. Harris, one of the best poets of our State. April is the beginning of mating time, and sometimes nesting begins by May 1. Two and sometimes three broods are reared in a year. The nest, of grasses, is built upon the ground. It is often placed in a fence-row; an old rail fence corner is a favorite spot, beside a stump, in a little protected place in a pasture or in a thinly vined berry patch. I have found them on the bank

of a little depression through a pasture, where many cattle continually passed, with no protection, and only their faith in the cattle keeping the path a yard away, could have impelled the birds to build there. The usual number of eggs is from 12 to 25. The average being 15 to 18. Sometimes one hears of nests having as many as thirty or forty. Undoubtedly such a number is the result of two or more laying in the same nest. This they occasionally do, and also sometimes they and chickens lay in the same nest. There have, undoubtedly, been great changes in the habits of these birds. The female does the sitting and cares for the family. Occasionally, when she has been killed, the male has been known to assume the task of sitting and fulfilling the duties of the mate.

Mr. John Wright, of Bartholomew County, told me of a nest in a fence-row, near which he often passed. He noted the eggs day after day, as they increased in number, and frequently saw the female. One day he was surprised to see the male sitting upon the nest. Examination showed some feathers of the female near by, marking the site of a tragedy in which she had been the victim. The male had taken up her duties. He watched him, and he stuck to his job. The young were hatched and faithfully they were cared for by the parent. He led them to the neighborhood of the corn field and near there he and they spent the winter. My father also tells of a similar instance. I have found the nest with fresh eggs as late as July 9 (1887). Mr. Robert Ridgway has found a nest containing fresh eggs, October 16, and there is one instance, given from Missouri, by Major Bendire, of a Bobwhite sitting on her eggs in January.

The Bobwhite is the bird of civilization. It and the farmer each fares best when they recognize they have united interests and one is dependent upon the other. While the birds eat wheat, oats, rye, barley, corn, buckwheat and other crop seeds, they get the most of it from gleanings of the fields, and at the same time eat seeds of smart-weed, butter-weed, rag-weed, partridge-berries, nanny-berries, wild grapes and various other wild fruits and weed seeds. They also eat blades of grass and other green foods, and in winter, acorns and beechnuts. Through the breeding season, and, in fact, the entire summer, they eat many insects—beetles, grubs, larvæ—enemies of trees, crops, and meadows. Dr. Howard E. Jones examined the crop of one accidentally killed in a potato patch in Ohio and found it contained seventy-five potato-bugs.

Mr. E. J. Chansler, of Bicknell, Knox County, informs me he has seen an old bird, with her brood, devouring chinch bugs. The mother would jump up and strike the cornstalks, knocking down many bugs,

which the young ate as soon as they touched the ground. These are some of the innumerable ways in which Bobwhite attempts to help his friend, the farmer.

How soon will the farmer realize the situation? A dozen covies of these birds upon a farm will do much to reduce the insect foes, and to lessen their damage, and also to destroy the seeds of innumerable noxious weeds.

There have undoubtedly been many changes in the habits of the Bobwhite since it came in contact with our race. Formerly they were very sensitive about having their nests disturbed. Now my friend, Mr. E. R. Quick, assures me they have, by reason of association, become accustomed to man and will permit one to remove their eggs from the nest and handle them. Prof. Cooke is satisfied the habit of "lying to a dog" is acquired. He shows that in the western part of Indian Territory they no more think of stopping when they see a dog than they would for a coyote; while, in the eastern part of the Territory, where they have become acquainted with dogs, they lie quite well for them (*Bird Mig. Miss. Valley*, p. 102). Whether or not they have the power to withhold their scent was a long-disputed question. From the experience of some close observers it would seem that they certainly think they have this power.

Proper regulations should be made by legislation for their protection, and thorough education be given the people as to the value of these birds. Mr. Thos. McIlwraith informs us that some time ago the government of Ontario passed an act prohibiting, under any circumstances, for a period of three years, the killing of quail. This law, coincident with mild winters, had the effect of increasing their numbers. Afterwards they again became less numerous. Doubtless there should be a law in our States protecting them for several years, and, after they have been given a chance to increase, they should be guarded through a close season, as at present. They are too valuable to permit them to become exterminated. I desire to call particular attention to the Hawks and Owls, which are treated later, in order that the reader may become acquainted with the kinds—for there are only certain kinds—that may be said to be destructive to our game birds. The really harmful are: Cooper's Hawk, Sharp-shinned Hawk, Goshawk, and the Duck Hawk.

SUBFAMILY TETRAONINÆ. GROUSE.

61. GENUS BONASA STEPHENS.

*121. (300). **Bonasa umbellus** (LINN.).**Ruffed Grouse.**

Head of Ruffed Grouse, natural size.

Adult Male.—Variegated reddish or grayish-brown; the back, with numerous oblong, pale, black-edged spots; neck-tufts, glossy-black; below, whitish, barred with brown; tail, varying from gray to rufous, with a broad subterminal black zone, and tipped with gray. *Female*.—Similar, but neck-tufts very small.

Length, 15.50-19.00; wing, 7.00-7.50; tail, 5.50-7.00.

RANGE.—Eastern United States west to Great Plains, from South Carolina and Arkansas to Minnesota, Vermont and Ontario.

Nest, a hollow in ground, lined with leaves or grass. *Eggs*, 8-14; milky-white to pinkish-buff, often with round spots of pale reddish-brown or drab; 1.58 by 1.18.

Resident. **Breeds**. The Ruffed Grouse is found in varying abundance throughout the State. It is a bird of the forest. Where there is the most forest, other things being equal, are to be found the most Grouse. Some places, where the woods are permitted to remain, they are common. The rougher, less fertile, and the wet, poorly-drained portions of the State are where the most timber is to be found, and there they are the most numerous. In the lower Whitewater Valley they are still to be found in some numbers.

The rougher hills covered with dense woods and underbrush are the places where they live. Mr. L. H. Haymond thinks they are nowhere to be met with in such numbers as in northern Indiana, northern Ohio, Michigan and Wisconsin. While they prefer the dense covert, they are occasionally found in buckwheat stubble, in the

open, in the fall. They are then even known to enter towns. I have a specimen that was shot from an apple tree in the yard of a neighbor in Brookville. Throughout the level and more thickly settled portions of the State they are becoming scarce.

Mr. Parker says they are rare in Cook County, Ill., but that a few are to be found in Lake County, Ind. Mrs. Jane L. Hine says they are common in Dekalb County. It has been reported in recent years from the following additional counties: Monroe, frequent (Martin); Carroll, rare (Evermann); Brown, common resident (Kindle); Decatur (Guthrie); Howard, rare (Woody); Starke (Deane); Allen (Stockbridge); Putnam (Clearwaters); Tippecanoe (Dr. E. Test); Steuben (Mrs. L. M. Sniff); Laporte (Barber); Elkhart (Juday); Knox, rare (Chansler); Boone, rare (Beasley); Parke, rare (Clickener); Benton, specimen in the State Museum; Kosciusko (Haymond); Porter (Parker); Wabash, becoming rare (Ulrey and Wallace). In the White-water Valley this bird is known as "Pheasant." In some other localities it is called "Partridge." These names but serve to confuse one, as it is neither; it is a Grouse. The term "Partridge" is also quite widely applied to the Bobwhite.

One of the characteristic sounds from the woods, where the Ruffed Grouse dwells, particularly in early spring, is the drumming of the male. I have notes of its drumming in this State as early as March 25, and through April and May it is most commonly heard, and one record is June 3, 1888 (Deane). It is said, some places, to begin drumming in February and to have been known to drum almost every month in the year. The sound is most often heard during the breeding season. I take the liberty of giving what Major Bendire tells us is the description of the method of drumming, by Mr. Manly Hardy, of Brewer, Maine, a reliable and careful observer. He says: "The cock Grouse usually selects a mossy log, near some open hedge, clearing or wood-road, and, partly screened by bushes, where he can see and not be seen. When about to drum, he erects his neck feathers, spreads his tail, and, with drooping wings, steps with a jerking motion along the log some distance each way from his drumming place, walking back and forth several times, and looking sharply in every direction; then, standing crosswise, he stretches himself to his fullest height, and delivers the blows with his wings fully upon his sides, his wings being several inches clear from the log. After drumming, he settles quietly down into a sitting posture and remains, silently listening for five or ten minutes, when, if no cause of alarm is discovered, he repeats the process.

"The drumming place is resorted to by the male from year to year. It may be a log, a rock, an old stump, or, when such are not available, a small hillock may be made to answer the purpose equally as well." (Bendire, L. H. N. A. Birds, I, p. 61).

The nest is generally a slight hollow at the foot of a tree or stump, or under the edge of an old log, in a fallen tree-top or brush pile. In this is put a few straws, a little grass or a few leaves. They generally lay from nine to twelve eggs. There are records where as many as sixteen to twenty-three eggs have been found in one nest. The nests which have come under my observation have contained eggs in May. That is the month when most of them lay. Full sets of eggs have been found as far north as Central New York, as early as April 1 (Bendire). Unfavorable weather at breeding time is disastrous to the Ruffed Grouse. Unlike the Bobwhite, they usually lay but one sitting a season, and, should these be destroyed, or the delicate young in their early days become chilled by cold winds accompanying a season of rain, if they lay again, as they are said sometimes to do, the set is a small one, but usually the year's increase is lost. Mrs. Hine informs me she once found a sitting Ruffed Grouse late in July. Mr. Haymond mentioned the year 1889 as the most disastrous year to these birds within his recollection. The previous year, 1888, there was a favorable breeding season, and they were found in great abundance. They are fully grown, or nearly so, by October 1. After this date they rarely take to the trees, though, when old and young are together through the summer, they are commonly to be found in them (L. H. Haymond).

The food of the Ruffed Grouse is quite varied. Grasshoppers and crickets are favorite articles of food. Besides these, caterpillars, ants, beetles, etc., are eaten. They live largely upon insects and fruits, including all the berries, during the summer.

In the fall they have been noted to eat, abundantly, leaves and blossoms of red clover, acorns, chestnuts, beechnuts, various seeds and partridge berries. In winter they eat seeds, grains, buds of laurel, apple, fern, wintergreen (*Gaultheria*), partridge berries (*Mitchella*), sumac berries, dogwood (*Cornus*), viburnum berries, and wild grapes. The crop of a Ruffed Grouse, taken at Brookville, May 10, 1879, contained the following: Three large beetles (*Phyllophaga hirsuta*), entire, but slightly crushed; numerous green seed-pods of the blood root (*Sanguinaria canadensis*); and a large mass of leaves of white clover (*Trifolium repens*), and ground ivy (*Nepeta glechoma*). The gizzard contained numerous seed stones of the Black Gum tree

(*Nyssa multiflora*), and remains of several of the beetles before mentioned (Jour. Cin. Soc. N. H., July, 1880, pp. 126, 127).

An excellent article upon this species, from the standpoint of a sportsman, by "Monoquet" (Mr. L. H. Haymond, of Warsaw), was published in the American Field, and is referred to in the bibliography.

64. GENUS TYMPANUCHUS GLOGER.

***122. (305). *Tympanuchus americanus* (REICH.).**

Prairie Hen.

Synonyms, PRAIRIE CHICKEN, PINNATED GROUSE.

Adult Male.—Sides of neck with an erectile tuft of ten or more rather stiff, elongated feathers with round ends, the longest of which are 2.50 or more in length; tail feathers, without bars or other markings, except the narrow whitish tip. *Adult Female*.—Smaller, with lesser neck tufts.

Length, about 18.00-19.00; wing, 8.60-9.40 (9.04); tail, 4.00-4.30 (4.16).

RANGE.—Prairies of Mississippi Valley; south to Louisiana and Texas; west to northern Indian Territory, middle Kansas, Nebraska, and eastern North and South Dakota; east to Kentucky, Indiana, northwestern Ohio, southeastern Michigan, and southwestern Ontario, Canada; north to southern Manitoba.

Nest, on ground. *Eggs*, 11-14; pale cream, olive buff or light brown, often finely spotted with reddish-brown; 1.66 by 1.24. Usually one brood.

Resident; formerly very abundant over the original prairie district, and now approximately confined to that district. In most places becoming scarce, in some very rare.

Generally known by one of the following names: "Prairie Chicken," "Chicken," or "Pinnated Grouse."

Within recent years they have been reported from the following counties: Common in Newton, 1894 (Pfrimmer); in Starke, 1892, 1894 (Dunn); rare in Carroll, 1889 (Evermann), 1894 (Sterling); Steuben, 1894 (Cass); Boone, 1895 (Beasley); Knox, 1888 (Balmer); Clinton, 1887 (Halleck); Wabash, 1895 (Ulrey and Wallace). Its occurrence has also been noted in the following counties: Lake, 1896 (Parker); Laporte, 1892 (Parker), 1894 (Barber); Benton (specimen in State Museum); Allen (Stockbridge); Dekalb, Steuben and Noble (McBride).

It is known that this species extends its range, sometimes, but I have nothing at hand to show that it did in this State. In counties like Carroll and Wabash it has confined itself to the prairie district.

Prof. W. W. Cooke has shown that west of the Mississippi River it has, to a certain extent, developed the habit of migration, which is more apparent some years than others.

They begin mating some years early in March. The following account of the love-making of these birds, by Judge J. D. Caton, a careful and well-known naturalist, is given: "The spring of the year is the season of courtship with them, and it does not last all the year round, as it does with humans, and they do it in rather a loud way, too; and, instead of taking the evening, as many people are inclined to do, they choose the early morning. Early in the morning you may see them assemble in parties, from a dozen to fifty together, on some high, dry knolls, where the grass is short.

"The cock birds have a loose patch of naked, yellow skin on each side of the neck, just below the head, and above these, on either side, just where the head joins the neck, are a few long black feathers, which ordinarily lay backward on the neck, but which, when excited, they can pitch straight forward. Those naked, yellow patches on either side of the neck cover sacs, which they blow up like a bladder whenever they choose. These are their ornaments, which they display to the best advantage before the gentler sex at these love-feasts. This they do by blowing up these air sacs till they look like two ripe oranges on each side of the neck, projecting their long black ears right forward, ruffling up all the feathers of the body till they stand out straight, and dropping their wings to the ground like a Turkey cock. Now they look just lovely, as the cosy, timid maidens seem to say as they cast side glances at them full of admiration and love.

"Then it is that the proud cock, in order to complete his triumph, will rush forward at his best speed for two or three rods through the midst of these love-sick damsels, pouring out as he goes a booming noise, almost a hoarse roar, only more subdued, which may be heard for, at least, two miles in the still morning air.

"This heavy booming sound is by no means harsh or unpleasant; on the contrary, it is soft and harmonious. When standing in the open prairie at early dawn, listening to hundreds of different voices, pitched on different keys, coming from every direction, and from various distances, the listener is rather soothed than excited. If this sound is heavier than the deep keynotes of a large organ, it is much softer, though vastly more powerful and may be heard at a much greater dis-

tance. One who has heard such a concert can never after mistake or forget it.

"Every few minutes this display is repeated. I have seen not only one, but more than twenty cocks going through this funny operation at once, but then they seem careful not to run against each other, for they have not yet got to the fighting point. After a little while the lady birds begin to show an interest in the proceedings by moving about quickly a few yards at a time, and then standing still a short time. When the actions are continued by a large number of birds at a time it presents a funny sight, and you can easily think they are moving to the measure of music.

"The party breaks up when the sun is half an hour high, to be repeated the next morning and every morning for a week or two before all make satisfactory matches. It is toward the latter part of the love season that the fighting takes place among the cocks, probably by two who have fallen in love with the same sweetheart, whose modesty prevents her from selecting between them."

Their nests are placed on the ground, in prairies, meadows, the edges or dryer parts of marshes and such other places as Bobwhites would be likely to select, and are lined with grass.

The number of eggs is usually from 8 to 13. In fact, there are two extremes of all the records I have from this State; generally they are from 9 to 11. Instances are recorded, from Nebraska, where the number was twenty-one (Kline, Ornithologist and Oologist, August, 1882, p. 150). Their eggs are frequently destroyed by high water, fire, the plow and mower, in addition to the many natural enemies of this bird. The year 1892, which, by reason of the high water in northern Indiana through May and June, was destructive to Bobwhite nests, was equally so to those of the Prairie Hen. Mr. Deane informed me, June 5, of seven nests found at English Lake, under water. The year before, he wrote me of two nests having been found where the meadows had been turned over. Under date May 4, 1890, Mr. Deane wrote me that that day Mr. R. A. Stafford, who had a dog with him, at Kouts, Ind., observed the dog flush a Prairie Chicken, which at that moment or just before had laid an egg upon the bare ground.

Nests are generally found with fresh eggs from late in April to early June. Mr. H. K. Coale found a nest at Tolleston, July 4, 1880, with 13 eggs. Major Bendire notes an instance where fresh eggs were found in August, indicating that occasionally a second brood is brought forth. The female sits and cares for the young. The exact period of incubation is unknown, but it is between three and four weeks. The young and adults at this season feed almost exclusively

upon insects, grasshoppers forming a prominent part. Cereals, grass, and weed seed are eaten. In the fall, when buckwheat is ripening in September, their favorite feeding ground is a buckwheat patch. The flocks collected at this season remain together, except as they are killed, until mating time next spring. Flocks contain from ten to forty birds.

XXIII. FAMILY PHASIANIDÆ. PHEASANTS, ETC.

a¹. Head and neck naked; forehead with conspicuous appendage.

MELEAGRIS.

65

SUBFAMILY MELEAGRINÆ. TURKEYS.

65. GENUS MELEAGRIS LINNÆUS.

*123. (310). *Meleagris gallopavo* LINN.

Wild Turkey.

Breast of male, with a tuft of long, coarse, hair-like black bristles; tail, bright umber, or dull ferruginous-brown, narrowly barred with black, and crossed near the end with a broad subterminal band of black; spurs, moderately developed. Female much smaller and duller-colored than the male; tip of tail and all of the upper tail covered with dark chestnut; prevailing hue of metallic reflections, coppery.

Length, 48.00-50.00; extent, 60.00; wing, 21.00; tail, 18.50; weight, 16 to 40 lbs. Female measurements, smaller in proportion; weight, about 12 lbs. (Ridgway).

RANGE.—Eastern United States, north to southern Canada, formerly to Maine; south to Florida and middle Texas; west to the edge of the Great Plains. (Bendire.)

Nest, on ground, lined with dead leaves and grass. Eggs, 10-14; creamy-white to creamy-buff, spotted and dotted with different shades of brown; 2.55 by 1.79.

Resident. Breeds. Formerly occurred in numbers throughout the State; now, in most places, extinct. My father tells me of turkey hunts in Franklin and Jefferson counties; of having killed them within the present limits of the present town of Brookville, and of trapping them in rail or log pens, some sixty or seventy years ago. The turkey pens had holes dug in the ground under one side large enough to admit the turkeys. A trail of corn led down into the hole, and inside the pen was plenty of corn. The birds followed the line of shelled corn, and suddenly found themselves inside the pen. They nevermore thought of looking down for the way by which they came.

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Prof. Evermann says they were common in Carroll County up to 70. Dr. Brayton, in 1879, said they were occasionally seen in rion County. They were seen in Crawford County last year (1896-97) (W. S. Blatchley).

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upon insects, grasshoppers forming a prominent part. Cereals, grass, and weed seed are eaten. In the fall, when buckwheat is ripening in September, their favorite feeding ground is a buckwheat patch. The flocks collected at this season remain together, except as they are killed, until mating time next spring. Flocks contain from ten to forty birds.

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Length, 48.00-50.00; extent, 60.00; wing, 21.00; tail, 18.50; weight, 16 to 40 lbs. Female measurements, smaller in proportion; weight, about 12 lbs. (Ridgway).

RANGE.—Eastern United States, north to southern Canada, formerly to Maine; south to Florida and middle Texas; west to the edge of the Great Plains. (Bendire.)

Nest, on ground, lined with dead leaves and grass. Eggs, 10-14; creamy-white to creamy-buff, spotted and dotted with different shades of brown; 2.55 by 1.79.

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I. ORDER COLUMBÆ. PIGEONS.

XXIV. FAMILY COLUMBIDÆ. PIGEONS.

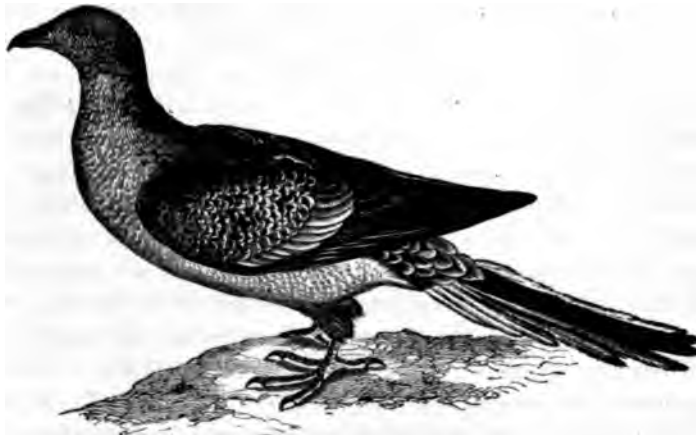
- a^1 . Tarsus shorter than lateral toes. Subfamily COLUMBINÆ.
 b^1 . Tail very long, wedge shaped, with 12 pointed feathers. ECTOPISTES. 66
 a^2 . Tarsus longer than lateral toes. Subfamily ZENAIIDINÆ.
 c^1 . Tail long, pointed, of 14 pointed feathers. ZENAIIDURA. 67

66. GENUS ECTOPISTES SWAINSON.

*124. (315). *Ectopistes migratorius* (LINN.).

Passenger Pigeon.

Synonym, WILD PIGEON.



Passenger Pigeon.

Adult Male.—Slaty-blue above, the wings and scapulars more brownish and spotted with black; the inner webs of the tail feathers have each a rufous and a black spot. The male has the whole head bluish-plumbeous, the foreneck and jugulum, rich cinnamon, passing into vinaceous on the breast, this gradually becoming paler posteriorly; the sides of the neck, richly glossed with metallic solferino-purple.

Female.—Head, foreneck, and jugulum, brownish-ashy or drab, gradually lightening posteriorly. (Ridgway.)

Length, 15.00-17.25; wing, 8.00-8.50; tail, 8.20-8.75.

RANGE.—Deciduous forest regions of eastern North America; west, casually to Washington and Nevada; Cuba.

Nest, of twigs, in trees. Eggs, 1 or 2; white; 1.47 by 1.02.

Migrant; formerly very abundant, but now rare; also rare resident. Have found them frozen to death in severe weather in the winter. Formerly bred throughout the State. Perhaps still does, rarely. In northern Indiana I think the greater number were migrants, though many were summer residents. These birds were gregarious, and moved about in flocks ranging in numbers from a few individuals to vast droves of incalculable numbers. They generally appeared in southern Indiana as migrants, some years arriving in September. The greater number passed south when severe weather began and returned in force in February and March. The great bulk went north into Michigan and other northern States to breed, nesting in large colonies. But many bred throughout our State, singly; and sometimes colonies of them nested. Their winter residence was determined by the quantity of mast, but in general it could be said to be somewhere in the area of the beech woods, at least in the Ohio Valley.

It is difficult for a young person to appreciate the accounts the older inhabitants give of the former abundance of these birds.

I am indebted to my father, now over eighty-seven years of age, and a native of the State, for many facts relating to these, and also other birds. He says, in 1831-2, the pigeon roosts in the vicinity of Vernon, which had become noted as the most extensive in that part of the State, were occupied by great numbers of pigeons. They moved in flocks so large the sky could not be seen in any direction as far as the eye could reach. They also nested in that locality in great abundance. The "roost" in the vicinity of Brookville, in the months of January and February, 1854, while not so large as many others, was so near home that accounts of it made an impression on my mind. One evening, when it was cloudy, my father went with a company of friends to it. The birds were much frightened by the shooting about their roost, and, just after sun-down, arose *en masse* and soared out of sight in the dusk of the winter evening, while from the direction of the cloud of birds came a noise as of a violent windstorm. As the darkness increased, the multitude descended and alighted upon the limbs of the forest trees in such numbers as to break many off. After night, the scene is described as one never to be forgotten. The squawking of the pigeons, the breaking of the limbs of giant trees beneath their living weight, the continuous rumble arising from the whirr of countless wings, the rapid firing of guns, produced an effect which no words can convey to one who has not experienced a night at a "pigeon roost." In 1869 Dr. Haymond said: "Still seen in large numbers, though evidently they have been constantly diminishing in numbers

for the last forty years, and are probably not half so numerous as they formerly were."

Hon. H. D. Johnson, a native of Franklin County, now a resident of Salt Lake City, Utah, informs me that, when a boy, some time between 1820 and 1830, he remembers going with some men to a "pigeon roost," in Springfield or Bath Township. He remembers its site was marked by an extensive windfall. There, upon the bushes, the pigeons nested in countless numbers, and the object of their visit was to catch squabs. He thinks they nested there for several years. Mr. B. S. Miner, of Leota, Ind., writes me of a roost in Scott County which existed from before he can recollect. He remembers it first in 1840. The birds would begin to fly to it in large flocks about one hour before night, and would continue, with intervals, till dark. When at roost they would break down the timber. They occupied the roost for two or three years, and then, after a few years' absence, would return. This continued until about 1855, since which date they have roosted there but one year; that was since the rebellion. They did not nest there. Mr. Angus Gaines says Pigeons once roosted in Knox County in vast numbers. Mr. W. W. Pfrimmer says they formerly nested in great numbers in the timber along the Kankakee River, in Newton County. Mr. Wm. Brewster, in his article "On the Present Status of the Wild Pigeon," says a man told him the largest nesting he ever visited was in 1876 or 1877. It began near Petoskey and extended northeast past Crooked Lake for 28 miles, averaging three or four miles wide. The birds arrived in two separate bodies, one directly from the south by land, the other following the east coast of Wisconsin, and crossing Manitou Island. He saw the latter body come in from the lake at about 3 o'clock in the afternoon. It was a compact mass of Pigeons, at least five miles long by one mile wide. The birds began building when the snow was twelve inches deep in the woods, although the fields were bare at the time. So rapidly did the colony extend its boundaries that it soon passed literally over and around the place where he was netting, although, when he began, this point was several miles from the nearest nest.

Nestings usually start in deciduous woods, but during their progress the Pigeons do not skip any kind of trees they encounter. The Petoskey nesting extended eight miles through hardwood timber, then crossed a river bottom wooded with arbor-vitæ, and thence stretched through white pine woods about twenty miles. For the entire distance of twenty-eight miles every tree of any size had more or less nests, and many trees were filled with them. None were lower than about fifteen feet above the ground. Pigeons are very noisy when

building. They make a sound resembling the croaking of wood-frogs. Their combined clamor can be heard four or five miles away when the atmospheric conditions are favorable. Two eggs are usually laid, but many nests contain only one. Both birds incubate, the females between 2 o'clock p. m. and 9 or 10 o'clock the next morning; the males from 9 or 10 o'clock a. m. to 2 o'clock p. m. The males feed twice each day, namely, from daylight to about 8 o'clock a. m., and again late in the afternoon. The females feed only during the forenoon. The change is made with great regularity as to time, all the males being on the nest by 10 o'clock a. m. * * *

Five weeks are consumed by a single nesting. Then the young are forced out of the nest by the old birds.

I can remember a number of interesting flights in my boyhood. About 1873 they were very abundant for the last time near Brookville. Prof. Evermann notes they were very abundant up to that time in Carroll County; but the last were seen in the fall of 1877, when a few hundred represented the countless numbers of half a century or less ago. That autumn I was at Hanover and shot a number from the extreme end of College Point.

"The nesting area situated near Petoskey covered something like 100,000 acres of land, and included not less than 150,000 acres within its limits, being in length about forty miles by three to ten in width. The number of dead birds sent by rail was estimated at 12,500 daily, or 1,500,000 for the summer, besides 80,352 live birds; an equal number was sent by water. We have, adding the thousands of dead and wounded ones not secured, and the myriads of squabs left dead in the nest, at the lowest possible estimate, a grand total of 1,000,000,000 Pigeons sacrificed to mammon during the nesting of 1878" (Prof. H. B. Roney, in *Chicago Field*, Vol. X, pp. 345-347).

Mr. Parker says the last year they were at all abundant in Cook County, Ill., was in May and June, 1881.

Mr. William Brewster visited the localities so well known as breeding grounds for Pigeons throughout Michigan in the spring of 1888. While the Pigeons had not made the flight they had in former years, still he assures us the flight was a large one. They passed beyond the lower peninsula and doubtless found a breeding ground remote from persecution. Mr. Brewster was of the opinion that there were left enough Pigeons to stock the West, provided they could be protected by adequate laws. (*The Auk*, October, 1889, p. 285, et. seq.).

They have not been protected, but steadily decreased in numbers so that some years I have not heard of a single Pigeon. In 1892 Mr. Pfrimmer shot two in Newton County. More were observed in 1894

than for two or three years. Mr. Barnett noted them in Brown County March 7 and April 5. In Laporte County a flock of 50 or more was seen April 10 (Barber). At Grand Haven, Mich., one was seen May 3 (Davidson). Near Manchester, Mich., observed June 13, September 9 and 12 (L. W. Watkins). Mr. E. J. Chansler says he saw a considerable flock in Knox County, September 1. Mr. Harbin saw a flock October 5. These are the first pigeons he has seen for years. In 1895 Mr. Barnett saw a flock of sixty, April 12, in Brown County. Mr. Ratliff reported twenty-five, April 18, at Richmond.

Prof. W. P. Shannon saw the wings of a Wild Pigeon that was killed near Greensburg in the winter of 1895-6 or the spring of 1896. It was alone when shot. About the same time Mr. John Wright saw six in Bartholomew County. Mr. E. J. Chansler reports a small flock from Flat Creek Bottom, near Wheatland, in 1896. In September, 1896, it was said several were seen in the eastern part of Franklin County, but I was unable to verify the report. Mr. J. F. Honacker says a small flock was seen near St. Peter's, Franklin County, October 21, 1897. Previous to that the last one noted in that county was a single one, February 28, 1890.

The passing of the Pigeon was a wonderful sight. Well do I remember, as a young boy, the long, dark lines of moving wings, and the noise of the propelling strokes. Their passing away must fill the soul of every one, into whose life their migrations have come as an experience, with profound regret. I introduce the lines of a careful observer, a faithful interpreter of nature, my friend, Hon. B. S. Parker. His "Hoosier Bards" are the feathered songsters of our beloved State, and therein he has preserved his recollections of the Passenger Pigeon:

"And windy tumults shake the ground,
And trees break down with feathered store,
And many swiftly-pulsing wings
Are spread at once in sudden fright,
Till every fleeting minute brings
The noise of some delirious flight,
And all the air is dark with swarms
Of pigeons in their quest for food,
While autumn leaves in eddying storms
Are beaten by the feathered flood."

67. GENUS ZENAIDURA BONAPARTE.

*125. (316). *Zenaidura macroura* (LINN.).**Mourning Dove.**

Synonyms, CAROLINA DOVE, TURTLE-DOVE.

Adult Male.—Brownish-olive, glossed with blue on the crown and nape; below, purplish-red, becoming tawny-white on the vent and crissum; neck, metallic-golden; a velvety-black spot on the auriculars and others on the wing coverts and scapulars; middle tail feathers, like back; the rest, ashy-blue at the base, then crossed by a black bar, then white or ashy-white; bill, very slender, black; feet, carmine.

Adult Female.—Paler, less metallic lustre. *Immature*.—Similar to female, but feathers with paler edges; no distinct black spot beneath ear.

Length, 11.00-13.00; wing, 5.70-6.10; tail, 5.70-6.50.

RANGE.—North America, from Panama and West Indies north to southern Maine, Canada and British Columbia. Breeds throughout the United States. Winters in Indiana and New York southward.

Nest, of twigs, in bush, tree, or on stump, log or ground. *Eggs*, 1 or 2; white; 1.10 by .84.

Common summer resident northward; southward, common resident. In the lower Wabash and lower Whitewater valleys they often spend the winter in small flocks, frequenting chosen places. Years when snow stays long on the ground they are to be found about corncribs and places where stock is fed. Some winters they are quite common. In the spring of 1883 all the specimens shot at Wheatland, Indiana, had the ends of their toes frozen off, showing that they had braved the almost unprecedented cold of the preceding winter. (Ridgway, *Birds of Ill.*, I, p. 499.)

A few pass the winter as far north as Terre Haute (Blatchley), Carroll County, Monroe County (Evermann), Brown (Kindle), Richmond (McCoy), Wabash (Ulrey and Wallace). Some winters they are found to the northern limits of the State, and even into Michigan, Wisconsin, and Ontario.

Their migrations in spring depend upon the season; sometimes they appear in middle and northern Indiana in February; usually they are seen by the middle of March, but in the extreme northern part of the State and in the vicinity of Chicago the records show that some years they do not appear until early in April.

In autumn they remain into November. Generally the greater number have left northern Indiana the first week of that month. They

begin cooing about the middle of March, in Franklin County; 1887, March 7; 1896, March 10. The nest is a frail platform, composed of sticks and roots, sometimes with a few leaves.

They mate early, and their nests, with complement of eggs, are often found early in April—April 5, Carroll County (Evermann); April 4, Franklin County; April 17, Lafayette (L. A. and C. D. Test). Their usual nesting place is in a tree or bush, from four to fifteen feet from the ground. In the bushes along the river banks their nests are especially numerous. They select as a nesting site Honey Locusts (*Gleditschia*) or Thorn (*Crataegus*) perhaps more often than all other trees. They often nest in orchards, and upon stumps from two to ten feet high. They are sometimes found breeding in company with the Purple Grackle. Mr. L. T. Meyer writes of a tendency of these birds towards breeding close together, possibly in colonies. In a very small patch of pine trees, in Lake County, he found ten nests. Occasionally nests are found built upon the ground, as they are throughout the treeless region of the West, but such is not often the case with us.

Both sexes share in incubation, the period being about two weeks.

They are generally through breeding by July, though the nest, with eggs, occasionally may be found all through the summer and into the early fall. When family cares are over they begin to collect in small flocks. Then they often are seen in the corn fields, which they continue to frequent into the winter. Their food consists of different kinds of grain, weed seeds, beechnuts, small acorns, worms and insects.

J. ORDER RAPTORES. BIRDS OF PREY.

SUBORDER SARCORHAMPHI. AMERICAN VULTURES.

XXV. FAMILY CATHARTIDÆ. AMERICAN VULTURES.

- | | |
|--|-----------------|
| a ¹ . Tail square; wings short, primaries of folded wings not reaching to end of tail; nostrils small and narrow. | CATHARTISTA. 69 |
| a ² . Tail rounded; wings long, primaries of folded wing reaching to or beyond end of tail; nostrils large and broad. | CATHARTES. 68 |

68. GENUS CATHARTES LILLIGER.

*126. (325). *Cathartes aura* (LINN.).

Turkey Vulture.

Synonym, TURKEY BUZZARD.

Adult. ---Head and upper part of neck, naked, the skin bright red, sparsely set with a few bristle-like feathers; bill, white; plumage, lustrous black, more or less edged with brown; tail, rounded; ends of

primaries reaching beyond the end of tail. *Immature*.—Similar, but skin of head and neck black, and more or less covered with whitish down.

Length, 26.00-32.00; extent, about 6 feet; wing, 20.00-23.00 (inches); tail, 11.00-12.00; culmen, 1.00; tarsus, 2.25-2.30.

RANGE.—America, from Patagonia to New Jersey, Ontario, southern Michigan, northern Indiana. Casually to Maine, the Saskatchewan, and British Columbia. Winters from southern Indiana southward.

Nest, in hollow trees and logs, and in cavities in rocks, and on ground. **Eggs**, 2, rarely 1 or 3; white or creamy-white, blotched, smeared or spotted with irregular markings of various shades of brown and lavender; 2.74 by 1.89.

Resident in southern Indiana, at least as far north as Vincennes and the lower Whitewater Valley. Some years they remain through the winter as far north as Brookville. They generally appear north to the center of the State in February or early March. Brown County, 1893, February 22 (Kindle); 1895, February 23; 1897, February 13 (Barnett); Wayne County, 1895, March 4 (Ratliff); 1897, March 22 (Hadley); Carroll County, March 16, 1884; March 12, 1885 (Evermann). Just as they gradually fade away in the fall, so they almost imperceptibly reappear in spring. The northern part of the State notes their return within the latter half of March, and they reach the southern shore of Lake Erie by early April—Sandusky, O., March 29, 1896; April 3, 1897 (Moseley)—and southeastern portion of Michigan, where it is rare, the latter part of April—(Petersburg, April 27, 1897; Trombley).

Mr. E. W. Nelson noted it as irregular and rare in Cook County, Ill. (Bull. Essex Inst., p. 120). Mr. J. G. Parker, Jr., tells me he has never seen it in that county, but that it is often observed at Kouts, Ind., thirty miles away. Plenty at "Crane Town," Jasper County, in April, 1887 (Trouslet). In southwestern Michigan it is also very rare. The Kankakee River seems to be the limit of its range, in northwest Indiana, and through the Wabash Valley it reaches the northeastern part of the State and adjacent portions of Michigan. It breeds throughout its summer range.

They mate soon after arrival, from the middle of March, in the southern counties. Eggs are found from April 25 through May. Most of them are laid before the middle of May, with us. They lay in a hollow tree or snag, in a prostrate hollow log, on the ground, beside a fallen tree, with no attempt to make a nest. In the Whitewater Valley they nest indiscriminately along the streams, on wooded hillsides

or summits, or in the more level woodland. The following measurements are from three sets collected near Brookville by my friend, Mr. E. R. Quick: 2.90 by 1.95; 2.70 by 1.90, deposited on ground beside a log, collected May 14, 1879. 2.95 by 1.95; 3.10 by 1.85, laid in hollow sycamore snag, six feet above ground and forty feet from the top, and only entrance; collected May 15, 1879. Incubation was far advanced in both sets. 2.75 by 1.94; 2.75 by 2.00, taken May 20, 1880; eggs fresh.

Mr. W. O. Wallace wrote me of a nest containing young found by a friend of his in Wabash County in the summer of 1894. When he first saw the young birds they were about the size of half-grown chickens, and entirely covered with white down. When they were disturbed they hissed loud enough to have drowned the noise of a hive of angry bees. They were at the bottom of a large elm tree stub, on the ground. After some effort, one of the birds was taken out of the hollow trunk. When it was teased it ejected the contents of its stomach, which proved to be a mass of half-digested garter snake.

They feed upon all kinds of carrion and fresh meat. The latter is their preference. There are, at different localities, places, where these birds congregate, known as "Buzzard Roosts." At such spots great numbers of these Vultures gather from a considerable area of country. One such is on the east Fork of the Whitewater River, about five miles north of Brookville. There, at almost any time in summer, these birds may be seen on the long limbs of the sycamores and elms along the river, resting or drying or preening their feathers after a bath. There is another well known roost at Shades of Death, near Waveland, Parke County. This overlooks the deep and rocky valley of Sugar Creek.

They begin to withdraw from the northern part of their range in October, sometimes early, others remaining until the close, and gradually disappear to the southward. Some years most of the migrants are gone by the last of that month; others remain until late November and even into December. Mr. E. J. Chansler writes me of a pure white Turkey Vulture that was seen in Knox County.

69. GENUS CATHARISTA VIRILLLOT.

***127. (326). Catharista atrata (BARTR.).**

Black Vulture.

Synonym, CARRION CROW.

Adult.—Head and upper part of neck, naked, black; the feathers reaching farther up on back of neck; bill, black at base, with white tip; plumage, uniform dull black; under part of surface of wings,

grayish or whitish. The heavier form, with square tail and short wings, with whitish lining, easily distinguish this bird.

Length, 23.00-27.00; wing, 16.50-17.50; tail, 7.50-8.50; culmen, .90-.95; tarsus, 3.00.

RANGE.—America, from Argentine Republic and Chili north to North Carolina, southern Indiana, southern Illinois, and west to Great Plains. Irregularly or casually to Maine, New York and South Dakota. Winters from southern Indiana southward.

Nest, on ground, under a log or bush, or in a hollow tree. *Eggs*, 2, occasionally 1 or 3; gray-green, irregularly marked with different tints of chocolate and reddish-brown; 3.09 by 2.01.

Resident in the southern part of the State; generally not numerous, but, in the lower Wabash Valley, at least from Knox County southward, it is common. In the lower Whitewater Valley it is seen most commonly in winter, but also breeds. The southern part of our State is mostly within the uncertain zone, which lies north of the territory where it is a common resident. It is not a migratory bird, but rather a wanderer which is liable to be found at any season, except that of breeding, within a narrow belt to the northward, and may even rarely breed there. Audubon, in 1834, said of this Vulture: "This bird is a constant resident of all our southern States, extends far up the Mississippi Valley, and continues the whole year in Kentucky, Indiana, Illinois and even in the State of Ohio, as far as Cincinnati." Apparently they withdrew from the vicinity of the Ohio Valley, and for over forty years there was no account of its having been observed there. The next record of its occurrence in Ohio was given by Dr. Langdon as December 20, 1876 (Bull. Nuttall Orn. Club, October, 1877, p. 109). The next record from Indiana was of two specimens observed at Brookville, May 17, 1879, by Mr. E. R. Quick (Journ. Cin. Soc. N. H., December, 1881, p. 341). From that time until the present it has regularly been seen in Indiana, in increasing numbers, and has extended its range northward until it has been found about half-way across the State. It would seem that here is a case of recession from a former area and of again extending its range to an equal or greater extent than formerly occupied. It has been noted as far north as the counties of Knox, Monroe, Decatur and Franklin, in 1890. Mr. O. P. Hanger noted it in Orange County in 1887 (The Curlew, I, No. 3, p. 35). Mr. Alden M. Hadley observed them at Monrovia, Morgan County, November 24, 1894. Mr. J. B. Burris saw several at Cloverdale, Putnam County, November 18, 1896. Mr. E. J. Chansler informs me they have become common at Bicknell, Knox

County, since 1889. Previous to that date they were seldom seen. The fall of 1894 they were quite common, and in the fall of 1895, at times in September, October and November, large flocks were observed. Both autumns there were many dead hogs in that vicinity, and the Black Vultures fed upon them. Mr. Robert Ridgway informs me of its breeding in Knox and Gibson counties, and I have reported an instance of its breeding four miles west of Brookville, in the valley of the West Fork of the Whitewater River, in May, 1889, in a hollow sycamore stub, about twenty feet high. The two eggs were placed upon the ground inside (Bendire, L. H. N. A. Birds, I, p. 167). They usually breed upon the ground, under bushes, logs, or sometimes entirely exposed. The eggs are usually two. Both sexes assist in incubation, which takes about thirty days. Probably but one brood is raised a season. They are generally known to our people by the name "Carriion Crow." It will be interesting to note whether they further extend their range as the years go by. The Black Vulture may be distinguished, by a careful observer, on account of its heavier body, square, short tail, which gives it a chopped off appearance, black head, and silvery grayish primaries. In some of the southern cities these Vultures are very tame, in fact, are semi-domesticated, but in Vera Cruz, Mexico, they may be said to be the sanitary police. They clean the streets and all public places of offal, and their value to the health of the people is very great. They are so tame that when engaged in feeding in the streets they grudgingly make way for the passer-by.

SUBORDER FALCONES. FALCONS, HAWKS, BUZZARDS, EAGLES,
KITES, ETC.

XXVI. FAMILY FALCONIDÆ. FALCONS, HAWKS, EAGLES,
KITES, ETC.

- α^1 . Outer toe reversible; claws all same length, narrowed and rounded on the under side. PANDION. 79
- α^2 . Outer toe not reversible; claws graduated from largest (hind toe) to smallest (outer toe).
- b^1 . Nostril small, circular, with a conspicuous bony tubercle; cutting edge of upper mandible with a strong tooth, separated from hooked tip of bill by a distinct notch. Subfamily FALCONINÆ. FALCO. 78
- b^2 . Nostril not circular, nor with an inner bony tubercle. Subfamily ACCIPITRINÆ.

- c*¹. Tail deeply forked. ELANOIDES. 70
*c*². Tail not deeply forked.
*d*¹. Wing not more than 18.00 inches.
*e*¹. Tarsus more or less naked in front.
*f*¹. Front of tarsus covered with small roundish scales; claws not grooved beneath. ELANUS.
*f*². Front of tarsus covered with large transverse scales; claws grooved beneath.
*g*¹. Cutting edge of upper mandible notched. ICTINIA. 71
*g*². Cutting edge of upper mandible not notched.
*h*¹. Face with a slight ruff as in owls. CIRCUS. 72
*h*². Face without a ruff.
*i*¹. Tarsus about equal to tibia; wings little longer than tail. ACCIPITER. 73
*i*². Tarsus usually less than three-fourths the length of tibia; tail much shorter than wing.
*j*¹. Nostril nearly ovate, its forward end pointed upward; wings rather pointed. BUTEO. 74
*j*². Nostril nearly circular; wings rounded. ASTURIA.
*c*². Tarsus densely feathered to base of toes, except a bare strip behind. ARCHIBUTEO. 75
*d*². Wing over 18.00 inches.
*k*¹. Tarsus feathered all round to base of toes. AQUILA. 76
*k*². Tarsus with at least lower third naked all round. HALIÆTUS. 77

SUBFAMILY ACCIPITRINÆ. KITES, BUZZARDS, HAWKS, ETC.

70. GENUS ELANOIDES VIEILLLOT.

128. (327). *Elanoides forficatus* (LINN.).

Swallow-tailed Kite.

Adult.—Tail, forked like that of some swallows; head, neck, band across rump, and lower parts, pure white; rest of plumage, glossy black, with reflections of varying shades. *Immature*.—Head and neck, streaked with dusky; black less glossy; feathers of wings and tail, more or less margined with white.

Length, 19.50-25.50; wing, 15.40-17.70; outer tail feathers, 12.50-14.50; culmen, 0.70-0.80; tarsus, 1.00-1.30.

RANGE.—America, from Brazil to Virginia, Indiana and Minnesota; rarely to Massachusetts, Ontario, Michigan, Manitoba, and Assiniboia. Breeds from Indiana, Illinois and Iowa southward. Winters south of United States.

Nest, of sticks and moss, in tops of tall trees. *Eggs*, 2-3; white, sometimes with greenish or yellowish tinge, spotted and blotched with brown, chestnut and umber; 1.87 by 1.49.

Rare summer resident in the southwestern part of the State; of rare and irregular occurrence northward. Wilson says of this graceful, swallow-like Kite, that it "is very abundant in South Carolina and Georgia, and still more so in west Florida, and the extensive prairies of Ohio and Indiana territory." (Am. Orn., VI, 1812, p. 70). They continued to grow less in numbers year after year. In Ohio, for twenty years after 1858, there was no record. From the time of Wilson down to the year 1882, a period of seventy years, with the single exception reported from Franklin County by Dr. Haymond (Indiana Geol. Rept., 1869, p. 210), it was not reported from Indiana north of the lower Wabash River. There Dr. F. Stein killed three, two males and female, in one season. Mr. Robert Ridgway noted it as a summer resident, but much less common than formerly. The specimen seen by Dr. Haymond was shot eleven miles below Brookville. It had been feeding upon beetles and cat-birds' eggs, which it had swallowed without breaking (Proc. Phila. Acad. Nat. Sci., November, 1856, p. 287).

Since 1882, whether because of increase of the number of observers or of its occurring more often, it has been noted several times north of the region named. A pair was shot, June 19, 1882, in Monroe County, Mich. (Bull. Nuttall Orn. Club, October, 1882, p. 250). It was noted in the following Indiana counties: Decatur, July, 1883 (Guthrie); Monroe, two, August 18, 1885 (Evermann); Allen, one, about 1885 (Stockbridge); Clinton, one, killed near Frankfort, July, 1885, and now in the possession of a man near there (Newlin); Mr. E. J. Chansler notes a pair in Knox County, in August, 1890, one of which is preserved by Mr. J. Freeman, Bicknell, Ind. He also reports another one seen April 11, 1894. Mr. J. A. Balmer mentions it, from Knox County. Mr. J. G. Parker, Jr., writes me of a male shot at Lake View, Ill., fifty miles north of Chicago, June 5, 1895. Their nesting time is from April to June. It will be observed that its distribution in this State corresponds closely with that of the original prairies. It has never been known to breed in Indiana, though I should not be surprised to learn that it does. Audubon found a nest near the Falls of the Ohio in 1820, which contained four young. They feed upon lizards, tree-toads, toads, grasshoppers, beetles and other insects, and they are decidedly beneficial. It is said to feed extensively on the cotton worm during the summer and early fall.

71. GENUS ICTINIA VIEILLOT.

129. (829). *Ictinia mississippiensis* (WILS.).*Mississippi Kite.**

Adult.—Tail, very slightly forked; head, neck and secondaries, ashy; rest of plumage, dark plumbeous, blackish on lesser wing coverts; primaries and upper tail coverts, marked with rufous chestnut; tail, black. *Immature*.—Head, neck and lower parts, white, spotted or streaked with brown; tail, tipped with whitish, and below with narrow cross bands of white or grayish; upper parts, brownish-black, marked with rufous or white.

Length, 13.00-15.50; wing, 10.60-12.30; tail, 6.00-7.00.

RANGE.—Eastern North America, from Guatemala north to South Carolina, southern Illinois, southern Indiana and Kansas. Casually to Pennsylvania, Wisconsin and Iowa. Breeds from Kansas and southern Illinois southward. Winters south of United States.

Nest, of sticks, twigs and leaves, lined with moss, in tops of tall trees. *Eggs*, 2-3; white, bluish-white or greenish-white.

Rare summer resident in the Lower Wabash Valley; accidental visitor elsewhere. Mr. Robert Ridgway informs me that it is found about the Cypress ponds of Knox County from May 15 to September. He notes that it breeds. Mr. Chas. Dury writes me, a specimen of a Mississippi Kite which was sent to him from Lafayette several years ago, which he supposes was killed near that place. Prof. A. J. Cook notes one specimen from Cass County, Mich. (Birds of Mich., p. 72). In the southern part of Illinois it is not uncommon, locally (Ridgway, Birds of Ill., I, p. 449). This species is another of the Kites that belongs to the harmless class of raptorial birds. Its food is much the same as last mentioned species.

72. GENUS CIRCUS LACÉPÈDE.

130. (831). *Circus hudsonius* (LINN.).*Marsh Hawk.**

Face encircled by a ruff of short, compact feathers, as in the Owls.

Adult Male.—Mostly of a uniform light bluish-gray, streaked with white; tail, barred with six to eight bands, the one nearest the end being broader and darker; tips of the wings, blackish. *Female and Immature*.—Dusky or rusty-brown, more or less streaked on head and neck. The Marsh Hawk may be easily distinguished in any plumage by the large white patch on the rump.

Length, 19.50-24.00; wing, 12.90-16.00; tail, 8.80-10.50. (Fisher.)

RANGE.—North America, from Panama and Cuba to Alaska. Breeds from Gulf States northward. Winters from Indiana and Maryland southward.

Nest, a collection of sticks, weeds, grass, twigs or moss, on ground, on prairies, marshes, bogs and meadows. **Eggs,** 3-8; white to pale bluish-white, sometimes faintly spotted with drab-gray, burnt umber or cinnamon; 1.77 by 1.39.



Head of Marsh Hawk.

Resident in northern Indiana; winter resident farther south. Breeds. Of rare or irregular occurrence in fall, winter and spring in the southeastern part of State. Its residence is confined more or less closely to the original prairie region. There, in the northern part of the State, it is a common, well known bird, and breeds. It is probable that it also breeds southward along the western side of the State. Mr. Deane reported a nest and six eggs taken, May 19, 1889, at English Lake. Audubon found it nesting in the Kentucky Barrens. It is also reported to breed in the following counties in this State: Knox (Balmer), Fulton (Bunnell), Dekalb (H. W. McBride, Feagler), Allen (Snyder). In Franklin County it has been seen but a few times. I have records of only four specimens.

They begin their wanderings away from the more open regions of the State in August and are most commonly seen through September, October and November. In spring they are most often observed in March and April. The quantity of food upon the meadows has more to do with the numbers of these birds in southeastern Indiana than the weather changes. They are much more often seen when the meadow mice are abundant. These birds are known as "Harriers" or "Mouse Hawks." The light blue or gray color of the adult male is not nearly as familiar as the brown and black plumage of the females and immature birds. The white rump, slender form, long tail and long, slender wings will distinguish it. It is thought they often remain paired throughout the year. They begin mating late in March

or early in April. The nest is usually placed in a marsh, on the ground or low bush, or other slight elevation. Nests may be found late in April and through May. The male assists in incubating. They frequently begin to incubate when the first egg is laid. The male often catches food and carries it to the female. The period of incubation is somewhat over three weeks. Both parents care for the young. But one brood is raised a season.

The food of the Marsh Hawk, as far as I have examined it in White-water Valley, is chiefly meadow mice, rabbits, squirrels and ground squirrels, lizards, snakes, frogs, and birds, grasshoppers, locusts and other meadow insects. The birds eaten are principally sparrows and other birds of the prairie and meadow. The food being so largely of injurious species, it is classed as one of the hawks that are mostly beneficial.

73. GENUS ACCIPITER BRISSON.

*a*¹. Tarsus feathered less than one-third the way down in front; the feathers well separated in front. Subgenus ACCIPITER.

*b*¹. Wing more than 8.75; tail decidedly rounded. *A. cooperi* (Bonap.). 132

*b*². Wing under 8.75; tail not decidedly rounded. *A. velox* (Wils.). 131

*a*². Tarsus feathered more than one-third (usually one-half) the way down in front; the feathers scarcely separated behind. Subgenus ASTUR.

A. atricapillus (Wils.). 133

Subgenus ACCIPITER.

*131. (332). *Accipiter velox* (WILS.).

Sharp-shinned Hawk.

Adult.—Uniform bluish-gray above; top of head, darker; tail, crossed by several blackish bands; wing, not more than 8.80 inches; tail, more than two-thirds as long as wing, its tip even or slightly notched; below, whitish, with breast and sides barred with dusky or rufous. *Immature*.—Above, dusky, more or less spotted with lighter, the feathers bordered with rusty; below, whitish, streaked with brown or dusky.

Length, 10.00-14.00; wing, 6.00-8.80; tail, 5.80-8.20. (Fisher.)

RANGE.—North America, from Panama north to southern Canada, and in the interior to Great Slave Lake. Breeds from southern United States northward. Winters from northern Indiana and from northern New York southward.

Nest, in trees, 15 to 60 feet up, of sticks, lined with bark and leaves. *Eggs*, 4-5; pale bluish, or greenish-white, blotched and spotted with various shades of brown, the darker ones predominating; 1.47 by 1.16.

Resident. Most of them leave the northern part of the State in fall and return in spring. In southern Indiana it is more often found in

winter than summer. Everywhere it is most numerous during the migrations. In some places it is considered rare at other times.

In fall the migrations occur in September and October; in spring, in March and April.

Mr. H. W. McBride found it breeding in Dekalb County. Mr. A. H. Kendrick says it breeds in Vigo County. Mr. L. T. Meyer found a nest containing two fresh eggs in Lake County, April 17, 1886. It was placed in a tall oak, and was composed of sticks and lined with bark. Dr. T. M. Brewer says Audubon speaks of having met with three nests, one in a hole in a rock, on the banks of the Ohio River, another in the hollow of a broken branch, near Louisville, Ky., and the third in the forks of a low oak, near Henderson, Ky. (N. A. Oology, Pt. I, p. 19).

This represents three types of nesting sites, but the habit of nesting in cliffs is very rare outside of the Arctic regions. The nest is generally large and well built. Sometimes they remodel the old nest of a crow or squirrel and use it. They are late in nesting. Usually fresh eggs are found late in April and in May, rarely as late as June 1. The eggs are laid at intervals of one and two days; incubation begins when the set is complete; meanwhile the female guards the nest. The male does not cover the eggs, but brings food to the female while she is thus occupied. The period of incubation is about three weeks. But one brood is reared in a year.

The three hawks of this genus, the Sharp-shinned, Cooper's, and the Goshawk, are among the most destructive and injurious of our hawks. They grade one into the other in size. The Goshawk is rare and is only seen in Indiana in winter. They are commonly known as Big and Little Blue-tailed Hawks, Darts or Darters, the present species being the Little Blue-tail. The greater part of their food is chickens, fowls and birds. These two species should be known by the name of "Chicken Hawk" or "Hen Hawk," instead of the larger Buteos. Our citizens, particularly farmers and poultry men, should take pains to learn these species, that they may be able to distinguish and punish the guilty and not the innocent. Investigations of 159 stomachs of this bird by the United States Department of Agriculture showed that nearly fifty kinds of birds had been eaten, and that no bird, from the size of doves, robins and chickens, were safe from its attacks. In fact, in 96½ per cent. of the stomachs containing food were the remains of small birds. While they rarely attack full-grown poultry, young fowls are a favorite food, and a brood, if exposed, is often entirely destroyed. One of the stomachs examined by me in December, 1886, was found to contain several large parasitic worms.

132. (833). *Accipiter cooperi* (Bonap.).*Cooper's Hawk.**

Synonyms, BIG BLUE HAWK, BIG BLUE-TAILED HAWK, LONG-TAILED DART, DARTER.



Cooper's Hawk.

(Fisher-Year Book, U. S. Dept. of Agriculture.)

Adult.—Uniform bluish-gray above, top of head, blackish; tail, crossed by several blackish bands; below, white, with breast and sides barred with dusky or rufous. *Immature*.—Dusky above, more or less spotted with lighter, feathers with rusty edges; below, whitish, streaked with brown or dusky.

Length, 14.00-20.00; wing, 8.85-11.00; tail, 7.80-10.50. (Fisher).

RANGE.—North America, from southern Mexico north to Newfoundland, Manitoba and British Columbia. Breeds from Gulf of

Mexico northward. Winters from northern New York and northern Indiana southward.

Nest, in trees, 20 to 50 feet up, of sticks, lined with twigs and bark (often use other nests, preferably crows' or squirrels'). *Eggs*, 2-6; bluish or greenish-white, sometimes indistinctly marked with brown or drab; 1.93 by 1.50.



Bill and Foot of Cooper's Hawk. Natural size.

Resident. In northern part of the State, rare in winter. Most numerous during migrations, and in summer. Some severe winters they are rare. Prof. Cooke says, in the winter of 1883-4, none were reported north of 38 degrees (Bird Mig. Miss. Valley, p. 114). It has been noted in the following counties, through the winter: Lake (Meyer), Fulton (Barnell), Carroll (Evermann), Monroe (Blatchley), Knox (Balmer), and Franklin. Breeds throughout the State. In fall they migrate—in September and October; in spring, in March. They are mated early in April and looking for nesting sites or repairing an old nest. The site is the fork or notch of some tree, generally from 20 to 50 feet from the ground. Sometimes they build a new nest, at other times they occupy that of the preceding year or even an old nest of some other hawk, or of a squirrel. The nests are sometimes very bulky, others well constructed and shapely. They begin laying in April, and full sets of eggs have been taken from April 25 to May 10. One brood is reared a year, though if the first laying is destroyed, a second, or, in case of loss of second, a third set has been known to be laid, sometimes in the same, sometimes in another nest. The eggs are deposited at intervals of one to two days, and incubation does not begin till the set is nearly completed. The female does most of the incubating and the male supplies her with food.

This Hawk is an exact copy of the Sharp-shinned Hawk, only it is larger. For that reason it is more destructive to large poultry, larger birds and pigeons. It is, in fact, the Chicken-hawk. Big Blue Hawk, Big Blue-tailed Hawk, Long-tailed Dart or Darter are some of its common names. In birds examined by me in fall and winter, one-half the food was small birds. They were also found to have eaten rabbits and mice. Of 133 stomachs of this Hawk reported upon by the United States Department of Agriculture, 34 contained poultry or game birds; 52, other birds; 11, mammals; 1, frog; 3, lizards; 2, insects, and 39 were empty. Dr. A. K. Fisher says it is by far the most destructive species we have to contend with. This is another, the chief one, of the injurious hawks.

This and the last species have learned that European Sparrows, usually called English Sparrows, are good eating and are frequently easily obtained, and in many localities have fed upon them in great numbers. In this way, at least, they are doing good service by destroying this imported pest. The characteristics of this species should be known, so that its attacks may be combated. Farmers and poultry-raisers should become thoroughly familiar with it. The aggregate damage done far exceeds that of all other birds of prey.

Subgenus *Astur* Lacépède.

133. (334). *Accipiter atricapillus* (WILS.).

American Goshawk.

Adult.—Above, bluish slate color, with blackish shaft streaks; top of head, deep black; tail, crossed by four dusky bands; below, white, thickly barred with narrow zigzag lines of gray; feathers often streaked in middle with dusky. *Immature*.—Above, dusky grayish, feathers margined with buff; below, whitish or pale buff, with narrow stripes of blackish.

Length, 21.00-25.00; wing, 12.00-12.45; tail, 9.50-12.75. (Fisher).

RANGE.—Northward. North America, from north Mexico, Kansas, Missouri, Kentucky and Virginia northward. Breeds from Maine northward; south in Rocky Mountains to California.

Nest, high up in large trees, of sticks, twigs, weeds, lined with grass and bark. *Eggs*, 2-5; soiled white, sometimes faintly blotched with brown; 2.31 by 1.74.

Rare winter visitor. Dr. F. Stein writes me he identified it in the lower Wabash Valley. Mr. E. R. Quick reports it from near Brookville in January, 1881. Mr. J. G. Parker writes me of its occurrence in Lake County in April, 1889.

The fact that it is not often found in this State relieves the farmer of one of the most destructive enemies of poultry. Its size, strength and activity and rapacity, added to its well-known fearlessness, render it, in localities where it is common, a great pest. Besides poultry, they eat Ruffed Grouse, Bobwhites and Doves, Rabbits and Squirrels. The report by Dr. A. K. Fisher on 28 stomachs of this species examined show that 9 contained poultry or game birds; 2, other birds; 10, mammals; 3, insects; 1, centipede, and 8 were empty (Bull. No. 3 Division of Orn. and Mam., U. S. Dept. of Agriculture, p. 46).

In some localities the Goshawk so persistently hunts the Ruffed Grouse that it is commonly known as "Partridge Hawk." Audubon tells us that, as he was passing down the Ohio, he observed one of these Hawks attack a flock of Grackles, which were crossing the river, and kill four or five of them. After killing each one by a squeeze, it was permitted to fall on the water. The Hawk finally returned and picked up all the floating birds.

In appearance, it is simply a larger Cooper's Hawk, which species it resembles in its flight and its hunting habits and its nesting.

It is said to breed in Michigan (Cook, Birds of Mich., p. 74), and in the mountains of Pennsylvania, where it has been noted by Dr. Warren (The Auk, July, 1897, pp. 317, 318).

74. GENUS BUTEO CUVIER.

*a*¹. Four outer primaries with inner webs emarginated.

*b*¹. Tarsus more than twice as long as middle toe. ***B. lineatus* (Gmel.). 136**

*b*². Tarsus less than twice as long as middle toe.

*c*¹. Tail irregularly mottled with grayish dusky, rusty and white, with dark band near tip; general color black or blackish; base of feathers pure white. ***B. borealis harlani* (Aud.). 135**

*c*². Tail, in adult, bright chestnut red above, with a narrow black bar near tip, brownish gray banded with black in young; general color dark brown, much barred and streaked. ***B. borealis* (Gmel.). 134**

*a*². Three outer primaries with inner webs emarginated; wing less than 12.00.

***B. latissimus* (Wils.). 137**

***134. (337). *Buteo borealis* (Gmel.).**

Red-tailed Hawk.

Adult.—Upper surface of tail, deep rusty rufous, with usually a black subterminal band; above, blackish-brown, variegated with gray, fulvous and whitish; below, white, with more or less buffy, belly streaked with dusky or brown. *Immature*.—Tail, bright gray, without any shade of red, and crossed by six to ten regular dark bands. A pronounced blackish zone across the upper part of the belly.



Fisher, Year Book, U. S. Dep. Agr., 1894.

RED-TAILED HAWK.

Length, 19.00-25.00; wing, 13.50-17.75; tail, 8.50-10.50. (Fisher).

RANGE.—Eastern North America, west to Great Plains; from Mexico to North Labrador, Manitoba and Northwest Territory. Breeds almost throughout its range.

Nest, in high trees, of sticks, twigs, grass, etc. *Eggs*, 2-4; white, often irregularly and variously marked with different shades of brown; 2.36 by 1.80.

Common resident; more numerous in southern two-thirds of the State, in most places, where it is the most abundant Buteo. In the region adjacent to Chicago all but a few have been destroyed. They



Head of Red-tailed Hawk. Natural size.

are slightly migratory, perhaps more some years than others, as they are more numerous during the migratory periods, August, September, and March and April.

This is the best known of the larger hawks, being in most places commonly known as "Hen Hawk," or Chicken Hawk. This name is a misnomer. Occasionally an individual of depraved nature becomes a chicken-eater, but as a rule it is exceptional for them to attack poultry. In an examination of twenty stomachs, made by me a few years ago, there were but two that had eaten chickens. One contained the remains of a Bobwhite; the remainder, principally mice and small rodents.

In his report on "The Hawks and Owls of the United States," Dr. Fisher gives the results of the examination of 562 stomachs of this

hawk; 54 of them contained poultry or game birds; 51, other birds; 278, mice; 131, other mammals; 37, batrachians or reptiles; 47, insects; 8, crawfish; 1, centipede; 13, offal; and 89 were empty. Sixty-six per cent. of its food is injurious mammals and but 7 per cent. consists of poultry. The Red-tailed Hawk greatly prefers the smaller mammals, reptiles and batrachians, and lives almost entirely upon them when they can be had. In their absence they often eat grasshoppers, crickets and beetles extensively. This is one of the species that is mostly beneficial and should accordingly receive proper protection. Some years they begin mating in February, and I have found them so engaged as late as April 21 (1887). They at once proceed to repair the old nest, which they generally use. In southern Indiana the favorite site is high up in the largest of the Shell-bark Hickories. One such nest I have known to be occupied for nearly twenty years. Their call note is given as "Kee-aah," very shrill. Another note of the breeding season is something like "Chirr" or "Pii-chirr" when perched near the nest (Bendire). I have never found its nest in the bottom lands, but in some regions they prefer such places. Mr. H. W. McBride obtained a nest, with eggs, in Elkhart County, March 24, 1891. Mr. L. T. Meyer informs me of a nest, with two eggs, incubation advanced, taken about 35 feet from the ground, in Lake County, April 19, 1885. Ordinarily, the most of our nests are found in March and April. Usually but one brood is raised a year. The eggs are laid at intervals of about two days. Sometimes, if the first eggs are destroyed, this Hawk will lay another set, and as much as a fourth laying has been known when something happened to the others. The period of incubation is about four weeks (Bendire). The male renders some assistance in this work, and at other times provides the female with food. When disturbed during nesting time, instead of attempting to defend their home, they usually fly about in circles high above, uttering their shrill screech. The following excellent notes are from the pen of Mr. H. W. McBride, a very enthusiastic collector, who has contributed many valuable records regarding the birds of northern Indiana:

"Next to the Red-shouldered Hawk, this is the most common hawk in northern Indiana. A few remain all winter, but most of them go south late in the fall, returning again early in the spring, the advance guard coming late in February, and by the middle of March they may be seen circling in pairs about their old nesting places. At this time they are quite noisy, and it is seldom that one or more can not be heard uttering their shrill "squeal," and soaring about over every patch of woods containing a couple of acres or more.

"I think they remain mated for life, as I have not only noted certain peculiarities of the birds occupying the same nesting site from year to year, but have been able to identify certain pairs by some peculiar shape or markings of the eggs.

"Toward the latter part of March they are at work repairing the old home, or, if it has been destroyed, in building a new one in the same locality, and by the first of April the females commence laying. The earliest date that I have taken the eggs of this species was March 29, 1890, when I took a set of two fresh eggs near Waterloo. This set is remarkable for several reasons. In the first place, at the time I took it, the weather was very cold, the ground was covered with snow, and the lower part of the nest was a solid mass of ice, the only dry and warm spot being the cavity, about eight inches in diameter, which had been covered by the bird. The eggs are also unusually large, measuring 1.98 by 2.50 and 1.99 by 2.49 inches. This set is now in the collection of Mr. H. W. Flint, of New Haven, Conn.

"From April 1st to the 15th, fresh eggs may be found, but after that date they are too far advanced in incubation for preservation.

"My observations would indicate that the period of incubation covered about 18 days.

"Out of about 25 sets of eggs I have taken the stages of incubation average as follows: Fresh, April 5; slightly incubated, April 8; incubation advanced one-half, April 12; nearly ready to hatch, April 17; young just hatched, April 21.

"On March 10, 1891, while after Great Horned Owls' eggs, near Waterloo, I saw a Red-tail fly from a large nest, and shot her. After ascending the tree and finding the nest completed, but no eggs, I opened the bird (female) and found a very large and completely formed egg, with a hard shell, and evidently about ready to lay. This would have been a record breaker, as it was nearly twenty days earlier than I ever found their eggs.

"The nests are large, made of sticks, lined with small twigs, leaves, and sometimes grass, and usually placed in the fork of a large tree—beech, oak or ash—anywhere from 35 to 100 feet from the ground.

"The birds generally leave the nest upon the approach of any one and remain at a good distance, circling about and uttering a peculiar "squeal" very unlike the harsh scream of the Red-shouldered Hawk.

"The usual number of eggs in the sets I have taken is *two*, and *never* have I found more than three. The largest set was taken April 13, 1890, a few miles from Waterloo, in Dekalb County, and is now in the State Museum at Indianapolis. My record book contains the following record of this set:

April 13, 1890. No. 21—337. Red-tailed Hawk. Taken $5\frac{1}{2}$ miles northwest of town (Waterloo), on the Golden Lake Road, in low, swampy woods on west side of road. Nest, rather large, in a large, leaning ash tree—70 feet from the ground. Bird left nest after I started to climb. Two very large eggs, 1.98 by 2.46 and 2.04 by 2.60, the largest I have seen. Incubation, one-third advanced."

135. (337d). *Buteo borealis harlani* (AUD.).

Harlan's Hawk.

Synonym, BLACK HAWK.

In Harlan's Hawk the tail is mottled with rusty, white, gray, and dusky; the rest of the plumage may vary from that of the typical red tail to nearly black. (Fisher).

Size, same as *B. borealis*.

RANGE.—Harlan's Red-tailed Hawk (*Buteo borealis harlani*), which until recently was considered a species, dwells in lower Mississippi Valley and Gulf States, east to Georgia, and extends casually to Kansas, Iowa, Illinois, Indiana and Pennsylvania.

Nest and *Eggs*, probably similar to those of *B. borealis*.

Accidental visitor. Mr. R. B. Williams, Lebanon, Ind., has in his possession a fine specimen of this Hawk. It was shot and its wing broken by Mr. W. H. Moler, of the same city, in Perry Township, Boone County, Ind., in September, 1887. He brought it while it was alive to Mr. Williams, who mounted it. This is the first record of the Black Hawk from Indiana. In Illinois, Mr. C. K. Worthen shot one of a pair on the Mississippi River, near Warsaw, Hancock County, in 1879. I have in my collection the skin of a specimen taken several years ago by Mr. W. S. Everhart, of Toledo, Cumberland County, Ill., in that county, and presented by him to me. This species is so rare that, while its habits and food are probably similar to that of the typical Red-tailed Hawk, it is of no value to us. Its plumage varies from much the same color of the true *borealis* to uniform black. The well known Indian Chief, Black Hawk, was probably named after this bird.

***136. (339). *Buteo lineatus* (GMEI.).**

Red-shouldered Hawk.

Adult.—Head, neck, and lower parts, more or less rusty or cinnamon, transversely spotted or barred with whitish; tail, black, crossed by about six bands of white. Above, reddish-brown, the center of the feathers darker than the edges. *Immature*.—Lower parts, dull

whitish, longitudinally spotted or streaked with dark brown; tail, dusky, crossed by numerous narrow bands of dull buffy or grayish-brown.

Length, 17.50-22.00; wing, 11.25-14.25; tail, 8.00-10.00. (Fisher).

RANGE.—Eastern North America, Mexico to Hudson Bay and Nova Scotia; west to Texas and Great Plain. Breeds throughout its range. Winters principally south of northern United States boundary.

Nest, in tree, of sticks, twigs, lined with grass. *Eggs*, 2-5; extremely variable, usually dull white, variously marked with brown; 2.15 by 1.70.

Resident, varying in numbers, locally, and with the seasons. In some localities in northern Indiana they are abundant in summer, and breed commonly. It is common and breeds in the lower Wabash Valley. In the southeastern part of the State, including the White-water Valley, northwest to Carroll and Wabash counties, it is not common in summer, but is more numerous during the migrations and in winter. While it breeds throughout the State, and, in fact, throughout its range, there are places where it is very common. In Connecticut and the southern portions of New York it is safe to say that its nests outnumber those of all the other birds of prey combined (Fisher, *Hawks and Owls of U. S.*, p. 65). In other parts of New York it is reported as follows: It is the commonest bird of prey in Oneida and Herkimer counties (Bendire, *L. H. of N. A. Birds*, I, p. 219). Common in Cayuga, Onondaga, Seneca and Wayne counties (Rathbun et al., *Rev. L. B. Cent. N. Y.*). Common southern resident in southern Ontario; more frequent there than any other "Chicken Hawk" (McIlwraith). In Wayne County, Ohio, it is more numerous than any other Hawk, outnumbering the Red-tailed Hawk about three to one (Oberholser). In southern Michigan it is more common than the Red-tailed Hawk at Bay City; common at Port Sanilac and in Kalamazoo County (Cook); also in Wayne County (Trombley). In Dekalb County, Ind., Mr. H. W. McBride says the Red-tailed Hawk is tolerably common, but the Red-shouldered is abundant. In Elkhart it is nearly as common. In Monroe it is about as numerous as *B. borealis*, and is common in Vigo (Evermann).

Mr. Robert Ridgway, in a recent letter, says, in Knox and Gibson counties, in Indiana, as well as Wabash, Lawrence and Richland counties, Ill., and in the district about Washington, D. C., the Red-shouldered Hawk is far more numerous than the Red-tailed. I am sure there are, in the counties mentioned in Indiana and Illinois, at least five times as many Red-shoulders as Red-tails, and I think the disparity of numbers was even greater in most places, fully ten to one.

It is probable that these localities will be found to connect, thus forming a narrow belt from the Atlantic coast to the Mississippi Valley, or beyond, where, under somewhat similar conditions, they may be found breeding in greater numbers than elsewhere. Into these favorite localities in Indiana and Michigan the migrants are found returning from the middle of February to the 25th of March. They begin mating at once. Generally an old nest is repaired and used. The nests are smaller and are not placed so high on an average as the Red-tail's, the range being, perhaps, from 20 to 65 feet. In northern Indiana they must begin laying by the middle of March. Mr. Ridgway has taken its eggs at Mt. Carmel, Ill., April 1, 1867 (Bendire, L. H. N. A. B., I, p. 223). Mr. Blatchley saw one on its nest near Terre Haute, April 1, 1891. In the northern part of the State it is commonly breeding and has full sets before April 15. Mr. H. W. McBride has had better opportunities to observe these Hawks than any one I know in Indiana. He says that the birds in immature plumage sometimes nest, and that he took a set of five eggs of such a bird in Dekalb County, April 22, 1890. He also was led to believe that a Red-tailed and a Red-shouldered Hawk mated that year. He examined the nest twice that spring and both times was attacked by such a pair. The wood was small; there were no other nests near, and he was unable to find any other Hawks in that vicinity. The Red-shouldered Hawk was killed before any eggs were deposited, and the other was seen no more. The following interesting notes were also furnished by Mr. H. W. McBride:

"By far the most common Hawk in northeastern Indiana. There is hardly a patch of woods containing an acre or more that is not the home of a pair of them, but unless the woods be very extensive, only *one* pair will be found nesting in it.

"The notes concerning the Red-tail will nearly all apply to this species also, as their habits are almost identically the same.

"As to the date of nesting, the Red-shoulder is perhaps a few days later than the Red-tail.

"I have taken, together with my father, about 80 sets of eggs of this hawk since 1884, and have examined several hundred nests. The variety of the eggs is infinite, and the size runs from that of the Cooper's Hawk to as large as the average Red-tail's egg. Some are nearly round, like an Owl's egg, some pear-shaped, some a perfect oval; and in markings they run from nearly a plain, dirty white to being so heavily marked by large blotches of brown and chocolate as to almost obscure the ground color. Below I give extracts from my notebook covering some of the more peculiar sets I have found:

"No. 5—339. Red-shouldered Hawk. Taken April 5, 1890, three miles northeast of Waterloo. In low, marshy woods. Nest in oak tree, about 75 feet from ground. Very small nest—probably an old crow's nest repaired. Birds very aggressive and repeatedly flew past my head as I was climbing. Eggs are very peculiar, being pear-shaped and finely speckled all over with lavender and brown. Four eggs. Incubation commenced.

"No. 34—339. Red-shouldered Hawk. Taken April 25, 1890, in same woods as No. 5 and about 200 yards from same place. Undoubtedly the same birds, as the eggs are exactly like those described above. Nest in large oak tree, *very* hard to climb. Birds very aggressive, as before. Three fresh eggs. On the edge of the nest was a large dead garter snake. This set is now in the State Museum.

"No. 27—339. Red-shouldered Hawk. Three fresh eggs taken April 18, 1890, three miles south of Waterloo. Eggs remarkably small, as small as those of Cooper's Hawk. Nest in large sugar tree, about 60 feet up, and was lined with an old Baltimore Oriole's nest. The birds were very bold and remained after I descended. I shot the female to assure myself as to the identity. This set is also in the State Museum."

Most persons give three as the common number of eggs, but four are probably as often found, and often five. The eggs are laid at intervals of two or three days. The period of incubation is about four weeks (Bendire). In this species both sexes share the labor of building, incubating and feeding the young. It is said, should the female be killed, the male will rear the young.

The Red-shouldered Hawk is mostly beneficial. In the immature plumage it is known as Winter Falcon. Its food is more varied than that of most Hawks. Under the direction of Dr. C. Hart Merriam, Ornithologist of the United States Department of Agriculture, the food of this Hawk was studied. Of 220 stomachs examined, three contained poultry; 12, other birds; 102, mice; 40, other mammals; 20, reptiles; 39, batrachians; 92, insects; 16, spiders; 7, crawfish; 1, earthworms; 2, offal; 3, fish, and 14 were empty. It was thus shown that at least 65 per cent. of their food consists of small rodents, while they and injurious insects amount to about 90 per cent. Hardly 1½ per cent. thereof was poultry and game. These valuable birds deserve and should receive the protection of every one, particularly the farmer.

Subgenus *TACHYTRICHIS* Kaup.***137. (343). *Buteo latissimus* (WILS.).****Broad-winged Hawk.**

Adult.—Above, dusky-brownish, darker on back; below, brownish, dull rufous, or rusty, more or less broken by white transverse spotting; lower belly, white, barred with dull rufous; tail, blackish, crossed by two to four bands of gray or brownish-white. *Immature*.—Entire under parts, dull white or buffy, with longitudinal brown or dusky streaks on breast and sides; tail, grayish-brown, crossed by five to seven narrow bands of dusky.

Length, 13.25-18.00; wing, 9.75-11.40; tail, 6.50-8.00. (Fisher).

RANGE.—America, from Ecuador north over eastern North America to New Brunswick, Hudson Bay. Breeds from Cuba and southern United States northward. Winters from New York and in Mississippi Valley from latitude 40° south.

Nest, in trees, of sticks, lined with strips of bark and leaves. *Eggs*, 2-4; dull grayish-white, spotted and blotched with different shades of brown, hazel, drab and fawn-color, also, sometimes, shell markings (Bendire); 1.93 by 1.56.

Resident in southern Indiana; summer resident northward. Not common. Most often seen in spring and fall. Mr. C. E. Aiken tells me it breeds in Lake County, and Mr. Robert Ridgway notes its breeding in Knox and Gibson counties. In the northern part of the State they depart from August till the coming of severe weather, and return in March or early April.

This *Buteo* is much smaller than either the Red-tailed or Red-shouldered. It nests later, usually in May or June. The nests are smaller, and sometimes a crow's nest is occupied. It has been known to nest in the fork of a tree, within three feet of the ground. The sites range from that to about 60 feet high. The eggs are deposited at intervals of one or two days. But one brood is raised. Both parents incubate and care for the young. The incubation period is from twenty-one to twenty-five days. The following summary of the stomachs of 65 of these Hawks examined shows that 2 contained small birds; 15, mice; 13, other mammals; 11, reptiles; 13, batrachians; 30, insects; 2, earthworms; 4, crawfish; and 7 were empty (Fisher, *Hawks and Owls of U. S.*, p. 83). This Hawk is valuable because of its destruction of mice and other mammals and insects. In the meadows it wages war upon grasshoppers, crickets, May beetles and other beetles; and in the orchards and woods, upon caterpillars, the larvæ of large moths, which feed upon the foliage. This Hawk is much more beneficial than otherwise, and is worthy of protection.

75. Genus ARCHIBUTEO BERN.

133. (347a). *Archibuteo lagopus sancti-johannis* (Gmel.).**American Rough-legged Hawk.**

SYNONYM, BLACK HAWK.

Legs, densely feathered in front and on sides down to base of toes. Width of bill at corners of mouth, 1.35-1.45 inches; head and neck, whitish, streaked with dusky. Above, irregularly varied with white, grayish, dusky or rusty; base of tail and feathers covering its upper surface, white; broad band near end of tail, grayish or dusky; below, whitish, usually with a band of dusky across front. Specimens are sometimes nearly uniform black.

Length, 19.50-23.50; wing, 15.75-18.00; tail, 9.00-11.00. (Fisher).

RANGE.—North America, north of Mexico, breeding north of the United States (excepting Alaska), from about latitude 49°; Quebec northward.

Nest, in trees or on rocks, of sticks, grass and weeds. Eggs, 2-5; greenish or dingy-white, streaked or spotted and blotched with various shades of dark and light brown, ochraceous and drab; 2.31 by 1.74.

Winter visitor of irregular occurrence; usually rare, except along the western side of the State, where it is more or less common. Some winters they are very abundant throughout the State. Each fall these birds come into the United States from their breeding grounds, far to the north, like an army. They are most numerous in the prairie districts, and the extension of their range depends upon food and weather conditions. In the vicinity of Chicago, Cook County, Ill., and Lake County, Ind., it is, during winter, the most common of the larger hawks. (J. G. Parker, Jr.).

In Knox County, Ind., it is usually common at the same season (Chandler). To the south and east of the Wabash River it is unusual to find them, but when they do appear it is almost always in some numbers. The winter of 1894-5 they extended their range as far as Boone County, where they were found in numbers.

Mr. J. E. Beasley wrote me, January 8, 1895, that he then had in his office at Lebanon six specimens, all from Boone County. One was taken near Greencastle, October 21 or 22, 1894 (Black).

The winter of 1886-7 they accompanied the great multitude of rapacious birds that spread over the States north of the Ohio River. They appeared in the southeastern counties of Indiana in December and remained until near April 1. Thirteen were reported from Decatur and Rush counties. They were equally abundant in Franklin. Some of the specimens in my collection, obtained that winter, repre-

sented the extreme of the black phase. They frequented the meadows, pastures and stubbles, where they fed upon the mice, which were so common that winter. They appear in the vicinity of Chicago from the middle to the last of October and in Knox County, Ind., from the 1st to the 20th of November. Some years they leave in February, but usually they remain well into March, sometimes to about April 1. March 12, 1887, Mr. E. L. Guthrie, of Adams, sent me one of six or seven noted in that vicinity. He said their principal food was mice, but he discovered one a few days before, feeding on the carcass of a dead lamb. Another person saw one eating the carcass of a dead skunk. The stomachs of six examined by me that winter contained nothing but mice and one rabbit. The summary of the report of the investigations made under the direction of Dr. Merriam, of the United States Department of Agriculture, shows that of 49 stomachs examined, 40 contained mice; 5, other mammals; 1, lizards; 1, insects; and 4 were empty. It is known also, at times, to eat grasshoppers extensively. It sits upon a low perch and watches for its prey, and also sweeps the meadow, prepared to seize a mouse, when it appears. They vary much in color, ranging from very light to nearly uniform black. Whenever they are with us they are valuable friends of the farmer. So far as we know, there is not a harmful thing they do. They are *wholly* beneficial. They breed far north, in trees, or upon cliffs. The eggs are deposited at intervals of two or three days. Incubation apparently begins before all are laid, and lasts about four weeks. One brood is raised a year. This Hawk is said to be of a very peaceful disposition, and soon becomes accustomed to permitting itself to be handled after a few days' captivity.

76. GENUS AQUILA BRISSON.

139. (349). *Aquila chrysaetos* (LINN.).

Golden Eagle.

Legs, densely feathered down to base of toes. This character will separate it, in any plumage, from the White-headed Eagle, which is the only other Eagle in the United States.

Length, 30.00-40.00; wing, 23.00-27.00; tail, 14.00-16.00. (Fisher).

RANGE.—Northern portions of Northern Hemisphere; south in North America to southern California, Mexico and Georgia. Breeds chiefly in mountainous regions throughout its range.

Nest, on cliffs, sometimes in trees; a collection of sticks. *Eggs*, 2-3; whitish, sometimes unmarked, usually more or less blotched, spotted or clouded with various shades of brown; 2.93 by 2.34.

Winter resident; occurs regularly, but is not common. It is said to have been more numerous formerly. There is no record of its having bred in Indiana; though Mr. C. L. Cass reports having observed a specimen at Clear Lake, Steuben County, August 17 and 18, 1894, and Dr. Joseph L. Hancock, of Chicago, saw one at Dune Park, Ind., August 7, 1897. It usually is not seen until late in November. A fine specimen was taken near Andersonville, November 24, 1895, and was alive when last heard from, the present summer (1897). A fine adult was taken near Indianapolis, November 29, 1891 (Noe). They disappear irregularly, not being seen usually over the greater part of the State after February, but sometimes remaining in the vicinity of Lake Michigan into March, or even April. One was noted in Porter County, April 25, 1887 (Trouslet). A pair were seen in Lake County, March 10, 1885 (Meyer); and one at Tracy Station, Starke County, March, 1884 (Coale). The greater number are seen in December, January and February. The winter of 1881, it was noted by Mr. E. R. Quick near Brookville, three times. In 1884, once, and 1889, twice, in the same vicinity.

December 18, 1895, one was caught in a steel trap, set for a skunk, and baited with a rabbit, near Fairfield, Ind. That same month one was killed near Waynetown, and is now in the collection of Wabash College, Crawfordsville. In addition to these, I have ten other records of its recent occurrence in this State. It is most often taken when the landscape is clad in snow, and the streams locked in ice. Their food is scarce, and they are often taken in traps, set for animals, or for owls, from which it has attempted to take the bait. While the Golden Eagle will occasionally carry off lambs, young pigs and poultry, and even attack animals as large as a calf, their natural food is rabbits, ground-hogs, grouse, waterfowl and other game birds. They are very destructive to the noxious rodents that damage the farmers' crops. Stories of their carrying off children have been usually found to have originated in the brain of man, and not in fact. Prof. Stanley Coulter informs me of one of these Eagles, that was killed by Mr. M. G. Jordan, Jordan Grove, White County, in December, 1896, as it was hovering over a litter of little pigs. Much has been said about the fierceness of the Golden Eagle, and its ability to defend its nest, yet those who have studied its habits say these statements are false, as these birds are cowardly, leaving the nest when persons approach it, and not returning till danger is past. They seem sometimes to mate before they leave us, in the spring. They breed in the mountainous parts of America. The nest is usually placed upon a projecting shelf, on the side of a high, steep cliff. In

California, however, most of the nests are placed in trees. The nest is large. Two or three eggs are a set, and but one brood is raised in a year. They begin nesting, in this latitude, in March, and continue through May, and even far north fresh eggs have been found in June. Several days, sometimes a week, intervenes between laying the eggs. Incubation lasts about four weeks. It is performed almost entirely by the female, who is supplied with food by the male.

77. GENUS *HALIÆTUS* SAVIGNY.

***140.** (352). ***Haliæetus leucocephalus* (LINN.).**

Bald Eagle.



Bald Eagle.

Lower third of leg naked all around. This character will separate it in any plumage from the Golden Eagle, which is the only other Eagle in the United States.

Length, 30-43; wing, 20-28; tail, 11-16. (Fisher).

RANGE.—Whole of North America, from Mexico to Arctic coast. Aleutian Islands, and Kamchatka. Breeds locally throughout its range.

Nest, large, in trees, or on cliffs; of sticks; sometimes lined with grass or moss. Eggs, 1-3; white; 2.90-2.27.

Resident locally; formerly common resident throughout the State, and still generally distributed in fall, winter and spring. Throughout the Whitewater Valley, where they formerly nested, and, in fact,

in all the region east and south of the Wabash River, it is not now known to breed. There they appear in October and November, and are seen until March, and sometimes late April. One was noted at Brookville, April 19, 1881. Its former occurrence led to a number of streams, fords and lakes, and other topographic features, receiving the distinctive name Eagle. It has recently been reported as breeding in Laporte County, 1885 (Byrkit); Knox County, 1886 (Ridgway); may breed yet, noted April 18 and 26, 1897 (Chansler); Porter County, near De Motte, 1894 (Pfrimmer). In Lake County it bred quite commonly 40 years ago. Still breeds in limited numbers in the tall trees along the Kankakee River (Meyer, Ball). Found breeding near Tolleston in 1871, and at Water Valley in 1886 (Aiken). August 8, 1887, Mr. F. M. Woodruff saw five Bald Eagles at Miller's, Ind., and shot one, which proved to be a young one. August 21, he took a female, and found a nest about one mile south of the sand hills in the pine timber.

In Starke County, at English Lake, they still breed regularly. I have reports from there for a number of years. In 1892 two pairs were found nesting within a half mile. One nest was found February 27, when it was repaired, and probably contained eggs. It was about 80 feet up in a dead elm. The other was found March 6. It was in the top of a tall sycamore (Deane). Mr. Joseph E. Gould took three fresh eggs from a nest in a sycamore tree, sixty-five feet up, at English Lake, March 19, 1893 (O. and O., April, 1892, p. 64). They formerly bred along the Tippecanoe River, in Carroll County (Evermann); and in Dekalb County, where it is possible they may yet, 1890 (H. W. McBride). One of their nests, built near the river about five miles west of Brookville, was used by them for many years. While in general the nest is in trees, from 20 to 100 feet up, it is sometimes found on projections of cliffs; on the coast of Texas, rarely, on the ground.

The nest is very bulky, and is often repaired, and used for many years. Nesting begins with us late in February, and continues through March, sometimes in April. Eagle Ford, near by, so-called on account of this well-known nest, will continue to designate the locality.

The eggs are laid at intervals of three or four days. Both birds take part in incubation, which lasts about a month. But one brood is raised in a year.

The Bald Eagle, in its adult form, is the emblem of the United States. It will, in that plumage, be readily recognized by its white head and tail. As in hawks, the female exceeds the size of the males.

The young have a greater expanse of wing than the adults, and have not the white head and tail. They do not assume perfect plumage until the third year. The first year they are black, and are known as the Black Eagle, also "Washington Eagle." The second year, they are commonly called "Gray Eagles." It is well to recall that this and the Golden Eagle are the only Eagles in the United States.

The favorite food of the Bald Eagle is fish. These it picks up on the beach, where they are strewn; takes by robbery from the Osprey; or, when it can get them in no other way, catches itself. February 24, 1891, Mr. R. Deane saw one of them fishing at English Lake. It poised in the air, after the manner of a Kingfisher, sustaining itself by rapid vibration of its wings, then suddenly "let go" and fairly dived to the water. This was repeated twice. Failing in procuring fish, it preys upon all kinds of waterfowl. They also eat lambs, small pigs and poultry. Mr. E. J. Chansler informs me of a Bald Eagle that was killed in Knox County, October 1, 1896, which had killed two lambs. Mice and other rodents form an important article of their food, and, all in all, they are considered to belong to that class of rapacious birds whose lives are mostly beneficial.

SUBFAMILY FALCONINÆ. FALCONS.

78. GENUS *FALCO* LINNÆUS.

- a*¹. Only first primary with inner web emarginated; first quill longer than the fourth; tarsus shorter than middle toe, and scarcely feathered below the knee; wing over 11.00. Subgenus *RHYNCHODON* Nitzsch.

F. peregrinus anatum (Bonap.). 141

- a*². Two outer primaries with inner webs emarginated; first quill shorter than the fourth.

- b*¹. Basal joints of toes with small hexagonal scales; tarsus about equal to middle toe. Size small; wing, 9.00 or less; sexes unlike.

Subgenus *ESALON* Kaup. *F. columbarius* Linn. 142

- b*². Basal joints of toes covered with transverse plates; tarsus longer than middle toe; size small, wing 8.00 or less; sexes different.

Subgenus *TINNUNCULUS* Vieillot. *F. sparverius* Linn. 143

Subgenus *RHYNCHODON* Nitzsch.

***141. (356). *Falco peregrinus anatum* (Bonap.).**

Duck Hawk.

Adult.—First and second wing feathers equal and longest. Top of head, black, decidedly darker than back; chest, creamy-buff, buffy-white, or pure white, often unspotted, never very heavily spotted with blackish. *Immature*.—Lower parts streaked with dusky. In Peale's Falcon, the top of the head is dark slaty, uniform with back; chest, heavily spotted with blackish.

Length, 15.50-20.00; wing, 11.30-14.75; tail, 6.00-9.00. (Fisher).

RANGE.—America, from Chili to Arctic coast. Breeds locally from the mountains of South Carolina, Arkansas and Lower California, north. Winters chiefly south of northern boundary of United States (New York and Manitoba south).

Nest, in cavity in trees, and on cliffs. **Eggs,** 3-5; pale creamy-white, sometimes overlaid with light chocolate, irregularly blotched, streaked and spotted with brown or reddish-brown; 2.10 by 1.68.

Resident, not rare, in Lower Wabash Valley. Throughout the remainder of the State, rare. Migrant. Breeds.

In the spring of 1878, Mr. Robert Ridgway discovered that this was by no means a rare bird in the heavy timber in the bottoms of the Wabash River, in the vicinity of Mt. Carmel, Illinois. Three nests were found there. All were placed in cavities in the top of very large sycamore trees, and were inaccessible. One of these trees was felled, and measurements with a tapeline showed the nest had been eighty-nine feet from the ground. It was placed in a shallow cavity, caused by breaking off of the main limb, the upper part of which projected sufficiently to protect it. Four fully feathered young were taken from the nest (B. N. O. C., 1878, pp. 163, 164).

Mr. Ridgway also informs me it breeds in Knox and Gibson counties, Ind. The Duck Hawk usually nests on the projections of cliffs, and the foregoing sites are unusual. It has been taken elsewhere in Indiana but a few times. A specimen in the collection of Mr. G. F. Morson was taken in Starke County, Ind., September 25, 1884. Mr. Toppan has noted it in Lake County in winter. There is a specimen in the collection in the State Museum, which Mr. J. E. Beasley informs me was taken near Slabtown, Boone County, May 14, 1896. This is the largest of the true Falcons. If the days of falconry were here, it would be considered of great value for such sport. It generally mates in February. In this latitude its nesting time is April and May. The eggs are deposited two or more days apart. Incubation is performed by both birds, and lasts about four weeks. But one brood is reared in a year. The late Col. N. S. Goss said, the males, as far as noticed, sit upon the eggs in the fore part of the day, and the females during the latter part. It is found to be one of the distinctively harmful species. If it were more common, it would do great injury. Its principal food is waterfowl, sandpipers, plover, snipe and such birds. It is also destructive to domestic poultry and pigeons. "Of 20 stomachs examined, 7 contained poultry or game birds; 9, other birds; 1, mice; 2, insects; and 4 were empty." (Fisher, Bull. No. 3, Div. Orn. and Mam., U. S. Dept. Agr., p. 109.)

Subgenus *ÆSALON* Kaup.**142. (357). *Falco columbarius* LINN.****Pigeon Hawk.**

Middle tail feathers, crossed by not more than four blackish or five light bands. Above, bluish gray or brownish; below, whitish, buffy, or light rusty; streaked with brownish or dusky. The Black Merlin is much darker. Above, plain brown; below, heavily marked with dusky.

Length, 10.00-13.25; wing, 7.40-8.60; tail, 4.65-5.50. (Fisher.)

RANGE.—America, from Ecuador to Arctic Ocean. Breeds from Maine to Iowa and California, northward. Winters from New York, Pennsylvania and Indiana, southward.

Nest, in trees, sometimes in cavities and on cliffs. *Eggs*, 4-5; pale creamy-white, often overspread by red-brown, and spotted and blotched with darker brown; 1.65 by 1.20.

Regular migrant, and irregular winter resident, not common. It is not improbable that it may rarely nest in the northern part of the State.

It is most often seen in September and October, March and April. In the Whitewater Valley, from which it was reported by Dr. Haymond (Ind. Geol. Rept. 1869, p. 209), it is now rarely seen. A specimen was taken near Valley Junction, O., in September, 1885, and one was taken near Brookville, Ind., October 20, 1880. A specimen was taken in Monroe County March 12, 1887 (Blatchley), and another was noted April 8, 1886, by Evermann, who also reports it from Carroll County. In Lake County Mr. H. K. Coale shot one September 25, 1875, and Mr. Aiken saw it at Water Valley. It has been noted elsewhere as follows: Dekalb County, two, in October (Mrs. Hine); Elkhart County, February 6, 1891 (H. W. McBride); Allen County (Stockbridge); Putnam County (Clearwaters); Boone County, one in collection of State Museum (Beasley); Laporte County (Byrkit). It builds nests on limbs of trees, in hollows of them, as well as in cavities or on projections of cliffs. In the southern part of its breeding range, it nests in March or April, while in Central Alaska and the Anderson River country, its nests are found in May or June. But one brood is raised in a season. Incubation lasts about three weeks (Bendire). Capt. Dall reports it as resident in Alaska.

The Pigeon Hawk is a true Falcon. It takes much of its prey upon the wing. This consists chiefly of small birds. Of 56 stomachs examined, 2 contained poultry; 16, insects; 41, small birds; 2, mice; and 5 were empty (Bull. No. 3, Div. O. and M., U. S. Dept. Agr., p. 113.



Fisher, Year Book, U. S. Dep. Agr., 1894.

SPARROW HAWKS. (Male and female.)

Fisher). When the number of "English sparrows," mice and insects it eats are considered, it seems to fall within the number of those Hawks that are mostly beneficial.

Subgenus *TINNUNCULUS* Vieillot.

***143. (360). *Falco sparverius* (LINN.).**

American Sparrow-hawk.

Male.—Tail, chestnut rufous, crossed by a broad black band near end; wings, grayish-blue, more or less spotted with black. Above, rufous, with or without black bars or spots. Below, varying from white to deep rufous, with or without black spots.

Female.—Tail, wings and back, crossed by numerous narrow bands of dusky.

Length, 8.75-12.00; wing, 6.55-8.15; tail, 4.20-5.60. (Fisher).

RANGE.—America, from northern South America to Newfoundland and Great Slave Lake. Breeds from Mexico and Florida, north. Winters from New York and Indiana, southward.

Nest, in hollow in tree or built among branches, or in cavity in cliff.

Eggs, 3-7; clear white to pale buff, variously marked with different shades of brown and ochraceous; 1.38 by 1.11.

Regular resident north to Wabash, Tippecanoe and Carroll Counties. In winter, rare north from there, more numerous southward. Everywhere common in summer.

This little Hawk is well known, and no visitor to the country will long await a sight of their busy forms. They begin to leave the northern part of the State in September, and some winters all leave. Severe winters they often seek protection; in one instance in January one was found in a stable, sharing a stall with a horse. Nowhere, perhaps, are they so numerous in winter. In more open winters, their numbers in the southern part of the State begin to increase in February. Migrations then begin and continue through March. In the Whitewater Valley I have always seen them mating in April. I have found their nest as early as April 11, but fresh eggs are found farther northward well into May.

A favorite nesting site is a Woodpecker's hole in a dead limb, at the top of a tall sycamore tree. The usual nesting site, in timber countries, is a hole, natural or otherwise, in the top of a tree; sometimes, however, they are made quite low. Other places, they occasionally nest in holes in cliffs or banks, or in the nest of some large bird, like a crow, and in buildings. In trees, the eggs are laid upon fragments of chips in the hole.

The incubation period is near three weeks. Both birds share in the labor. They are very watchful of their charges, and many a spirited encounter is had to drive some intruder from the neighborhood. Usually, but one brood is reared each season. When disturbed, they have been known to lay a second and third set of eggs. However, eggs have been found as late as August, indicating, possibly, more than one brood in a season. In July and August, when old and young are found together, along the farm fences, they are most often seen. From the report prepared by the United States Department of Agriculture, we learn that of 320 stomachs examined, 1 contained a game bird; 53, other birds; 89, mice; 12, other mammals; 12, reptiles, or batrachians; 215, insects; 29, spiders; and 29 were empty (Bull. No. 3, Div. O. and M., Fisher, p. 127). At times it is known to attack young chickens and beneficial birds. A telegraph line is a favorite place for these Hawks. There, particularly at the time of the spring migrations, every few poles will be found to form a point of observation for them. From this point they wage war upon the mice and other small mammals along the roadway and in adjacent fields. They subsist largely upon grasshoppers, and other insects, especially in late summer and early fall, before the vegetation is cut down by the frost. Upon the Mexican plateau, in winter, I found these birds as much at home as they are with us. They were quite common, and lived chiefly upon insects. The lives of these birds are mostly beneficial. They should receive protection at our hands.

SUBFAMILY PANDIONINÆ. OSPREYS.

79. GENUS PANDION SAVIGNY.

***144. (364). *Pandion haliaetus carolinensis* (GMEL.).**

American Osprey.

Claws of the same length, narrower and rounder on under side. Above, plain dusky-brown, tail more grayish, narrowly tipped with white, and crossed by about six or seven narrow bands of dusky; head, neck and lower parts, white; the chest sometimes slightly blotched with brown; sides of head with dusky stripe, top more or less streaked with dusky.

Length, 20.75-25.00; wing, 17.00-21.00; tail, 7.00-10.00.

RANGE.—America, from northern Brazil to Labrador, Hudson Bay, and Alaska. Breeds throughout its North American range. Winters from South Carolina, and rarely in Southern Indiana, south.

Nest, bulky, of sticks, reeds, cornstalks, etc., lined with grass, corn blades and other fine material, in top of tree, on cliff, or on ground.

Eggs, 2-3; creamy-white or buffy-white, blotched and spotted with brown and vinaceous red; 2.44 by 1.77.

Locally summer resident; regular migrant, and some winters rare winter resident in the southern part of the State.

The winter of 1880-81 they were seen a number of times along the Whitewater (E. R. Quick), and have been noted other years. Along the Wabash River, it has been observed in winter as far up as Lafayette (Moffitt), and it was also noted in Putnam County, the winter of 1888 (Clearwaters). Usually they begin, when not found in winter, to appear upon our larger streams with the disappearance of the ice, generally in February. The greater number of them, however, are seen in April, in the Whitewater Valley, between April 2 and 29. In the fall they begin to appear there by September 6, and are sometimes common until October 7. Mr. V. H. Barnett saw one in Vermillion County, August 31, 1897.

In the vicinity of Michigan City, it is abundant along the lake in summer (Byrkit).

Mr. Ruthven Deane saw it in Starke County, June 10, 1888. Mr. T. H. Ball says they formerly nested along the Kankakee, and a few yet remain. Mr. Robert Ridgway informs me of its breeding in Knox and Gibson counties. In the spring of 1893, Mr. Joseph F. Honacker reports finding a nest, a short distance below Lafayette. They will probably be found, by persistent investigators, to breed in other parts of the State.

Mr. H. W. McBride found them in Steuben, Lagrange and Elkhart counties early in May, 1891, and in Dekalb County, May 12, 1890. They breed commonly along the coast, and not so numerous in the interior, as far north as Labrador, Hudson Bay and the Yukon, in Alaska. It generally builds its nests on the top of trees, but sometimes on or in cliffs, and on the ground. The same nest is occupied for years. The eggs are deposited at intervals of one or two days, and the period of incubation is given as 21 days, but Maj. C. E. Bendire thinks it is nearer 28. A single brood is raised in a season, though other sets may be laid if the first one is destroyed. In this latitude they nest from about April 25 to June. The Osprey is commonly called Fish Hawk, or Fishing Eagle.

Its food consists entirely of fish, which it usually captures. It is a famous fisher, catching food not only for itself, but often for the Bald Eagle, which robs it of its catch. Mr. Chas. S. Shick, of New Jersey, says: "It is interesting to watch the Fish Hawk obtaining its food, sailing along from 50 to 100 feet above the water; with its keen eyes it can easily see any fish swimming close to the surface of the

water, and as soon as it sees its quarry, stops its flight, and remains suspended motionless in the air for a moment, closes its wings, and then darts downward like an arrow. It disappears under the water for a few seconds, and when it arises and again takes wing, a shining, wriggling fish can be plainly seen in the grasp of its powerful talons. It is a curious fact that this bird will never carry the fish with the tail to the front. Many times have I seen them turn the fish around in mid air" (Bendire, L. H., N. A. B., I., pp. 321, 322).

The Osprey often selects a tree, sometimes miles from any water, where it resorts to devour its food.

SUBORDER STRIGES. OWLS.

XXVII. FAMILY STRIGIDÆ. BARN OWLS.

Characters same as family.

STRIX. 80

80. GENUS STRIX LINNAEUS.

*145. (365). *Strix pratincola* BONAP.

American Barn Owl.

Facial disk not circular, but somewhat triangular. Middle and inner claws of equal length; inner edge of middle claw, jagged; wing, long, reaching beyond tail when folded; tail about half the length of wing.

Color.—Above, ochraceous-yellow, more or less marbled with white or ashy, and speckled with black, and sometimes with white spots. Below, varying in every degree from silky white to bright tawny, dotted with black spots. Eyes, small, black.

Length, 15.00-20.00; wing, 13.00-14.00; tail, 5.75-7.50. (Fisher).

RANGE.—North America, from Mexico north to Massachusetts, New Jersey and Ontario, Michigan, southern Minnesota and Oregon. Breeds from southern New York, northern Indiana, southward. Winters from northern limit of breeding range southward.

Nest, in steeple or barn loft, or in a hole in tree or bank. Eggs, 5-11; dead white; 1.65 by 1.31.

Found throughout the State; locally resident; rare northward; more numerous in the Wabash Valley and southward. Breeds.

In 1879 there were but five known records of its occurrence in Ohio. It was then considered a very rare visitor. At that time there was no record of its occurrence in Indiana. And as far as I have since heard, the only one who had met it was Dr. F. Stein, who noted it in the lower Wabash Valley. In Illinois it was considered rare in

1878. Mr. Nelson had noted two taken near Chicago. The year 1883 is notable for a sudden increase in the number observed north of the Ohio River. In October of that year ten Barn Owls were killed near Cincinnati, several of which were found occupying the tower of the town hall at Glendale, O. On October 18th, Mr. Chas. Dury visited the town hall at Glendale. Four Barn Owls flew out. I give some extracts from Mr. Dury's account. The floor and ledges were covered with the cast-up pellets of the birds.

"With Owls the indigestible matter is formed into balls in the stomach, and afterwards cast up. These are called pellets. They covered the floor several inches deep in places. I examined many of them, and found them made up entirely of the hair and bones of



Foot of Barn Owl. Natural size.

the smaller rodents, mostly mice. There must have been the debris of several thousand mice and rats. But the strangest part of the curious habitation was the flock of domestic pigeons that were living, seemingly, on intimate terms with the Owls, and judging from the old pigeon nests, I presume the pigeons had actually nested and reared young there" (Journ. Cin. Soc. N. H., Dec., 1883, pp. 237, 238.) Soon afterwards two Barn Owls were taken at Monroe, Ohio.

These birds also spread into Indiana. October 25, 1883, the only one ever reported in the Whitewater Valley was killed near Brookville. There is one in the collection at the State Museum that was taken at Franklin, December, 1883. They bred near Frankfort, Clinton County, in the summer of 1889. In Vigo County young were taken about July 18, 1890. In the north part of Tippecanoe County, two young were taken from the nest in a hole in a large elm, about June 15, 1890. The winter of 1891-92, Mr. Fletcher M. Noe received three of those owls taken in this State. The following additional records are at hand: January 19, 1893, one was found dead in an old

house in Decatur County (W. P. Shannon, October 7, 1893); one was taken alive, five miles north of Greencastle, and brought into that city (J. Earlle); November 10, 1894, one was picked up dead ten miles southwest of Lafayette (L. A. and C. D. Test). In 1894, Mr. J. O. Dunn supplied two records from the vicinity of Chicago, September 25. About June 10 he saw one alive in a saloon window on La Salle street. He procured one from a small boy, which he still has.

One was picked up alive by Mr. Wm. Baum, three miles south of Delphi, August 30, 1897 (D. C. Ridgely). May 23, 1896, a female was shot on the Kankakee River, at Kouts, Ind., by Mr. M. F. Hilgard, which is now in the collection of Mr. J. G. Parker, Jr., who says it undoubtedly had a nest close by. Prof. E. L. Moseley reports one from Sandusky, O., April 11, 1896. He informs me a local taxidermist had received two others. Mr. J. B. Burris (Cloverdale, Ind.) writes one was shot from a pine tree in a neighbor's yard, March 20, 1897. It has also been noted from the following counties: Wabash (Ulrey and Wallace); Boone (Beasley); Allen (Stockbridge).

With us, these birds seem to frequent, except at the breeding season, the belfry and tower of buildings, barns and deserted buildings, and nest in hollows of trees. This is the bird that is written up in the newspapers as the "Monkey-faced Owl." They also nest in deserted mine shafts, old wells, the burrows of animals, holes in banks and cliffs. They make little or no nest. "Incubation usually commences with the first egg laid, and lasts about three weeks. The eggs are almost invariably found in different stages of development, and young may be found in the same nest with fresh eggs. Both sexes assist in incubation, and the pair may be sometimes seen sitting side by side, each with a portion of the eggs under them" (Bendire, L. H., N. A. Birds, I, p. 327). The examination of stomachs under the direction of the United States Department of Agriculture showed that "of 39 examined, 1 contained poultry; 3, other birds; 17, mice; 17, other mammals; 4, insects; and 7 were empty." (Fisher, Bull. No. 3, Div. O. and M., p. 139). It is one of the most decidedly nocturnal of the owls. At dusk it goes forth to hunt; over meadow and marsh, pasture and prairie, its quest leads it. Its game is meadow mice, gophers and other destructive mammals, all more or less injurious. Its work is highly beneficial. The farmer and orchardman especially should give them protection.

XXVIII. FAMILY BUBONIDÆ. HORNED OWLS, ETC.

- a*¹. Wing more than 10.00 inches.
*b*¹. Cere longer than rest of culmen; iris yellow; external ear very large. ASIO. 81
*b*². Cere short.
*c*¹. Ear tufts very conspicuous; size large. BUBO. 86
*c*². Ear tufts very small, or none.
*d*¹. Toes entirely covered with feathers; bill nearly hidden by feathers.
*e*¹. Tail 10. inches or less; plumage mostly white. NYCTEA. 87
*e*². Tail over 10. inches; plumage not white. SCOTIAPTEX. 83
*d*². Toes not entirely covered with feathers; bill large, yellowish. SYERNIUM. 82
*a*². Wing less than 10. inches.
*f*¹. Ear tufts conspicuous. MEGASCOPS. 85
*f*². Ear tufts none.
*g*¹. Wing over 8. inches. SURNIA. 88
*g*². Wing under 8. inches. NYCTALA. 84

81. GENUS ASIO BRISSON.

- a*¹. Ear tufts well developed, of 8 to 12 feathers. Subgenus ASIO.
A. wilsonianus (Less.). 146
*a*². Ear tufts not conspicuous, of few feathers. Subgenus BRACHYOTUS Gould.
A. accipitrinus (Pall.). 147

146. (366). Asio wilsonianus (Less.).*American Long-eared Owl.**

Ear tufts conspicuous, containing eight to ten feathers, and about as long as middle toe with claw.

Color.—Above, dusky, mottled with gray, tawny, and blackish. Below, grayish-white, with confused marbling of brown, black and tawny, many feathers with a median longitudinal dusky stripe, which gives off transverse bars. Feet and legs, tawny and unspotted.

Length, 13.00-16.00; wing, 11.00-12.00; tail, 5.50-6.50. (Fisher).

RANGE.—North America, from Valley of Mexico to Nova Scotia, Hudson Bay (and latitude 61 degrees). Breeds throughout its range. Winters in Maine, Northern New York, Michigan and Minnesota.

Nest, in trees, using an old nest of some bird or squirrel, in cavities in cliff. *Eggs*, 3-6; oval; pure white.

Resident, not common in summer; more numerous in winter. Breeds.

The Long-eared Owl is more numerous than is generally thought. It is the woodland species of this genus, as the Short-eared Owl is the prairie representative. Its woodland retreats, retiring ways, and

habit of frequenting certain localities, make it inconspicuous. Except at the mating season, it is rather quiet. Some years they are more numerous in winter than others. In Southern Indiana they have been most commonly noted from October 18 to January 30. Mr. J. A. Balmer informs me it breeds in the lower Wabash Valley. Dr. Langdon notes that Mr. Dury took full-fledged young of the year, at Avondale, Ohio, in July, 1878. April 29, 1890, Mr. H. W. McBride shot two old ones and caught two young ones in Dekalb County. With us, they must begin laying late in March or early in April. In Wayne County, Mich., Mr. Jerome Trombley reports nests with five eggs, taken in May. (Cook, Birds of Mich., p. 80.)

Almost always this Owl repairs and uses the old nest of a bird or a squirrel; occasionally it is said to build a nest for itself. The eggs are deposited at intervals of one or two days. Incubation begins with the first egg laid and lasts about three weeks. If the first setting is destroyed, another, and sometimes a third, will be laid. The female incubates, but the male is usually near by. This species, unlike the Short-eared Owl, does all its hunting by night. By day it keeps hidden in the seclusion of some dark woods or dense thicket. In winter they select a particular spot, and in early spring the ejected pellets lie beneath the perch in great numbers. In them the naturalist will find recorded much of the zoological history of the past winter of the neighborhood. Dr. A. K. Fisher gives us the result of the examination of 107 stomachs examined: 1 contained a game bird; 15, other birds; 84, mice; 5, other mammals; 1, insects, and 15 were empty. (Bull. No. 3, Div. O. and M., U. S. Dept. Agr., p. 145.) Please note what a great proportion of injurious animals these birds destroy. Of the stomachs which contained food, over 93 per cent. contained the remains of small mammals. They are the friends of agriculture. Be careful to protect them.

***147. (367). *Asio accipitrinus* (PALL.).**

Short-eared Owl.

Ear tufts inconspicuous, much shorter than middle toe, with claw.

Color.—Whole plumage varying from bright tawny to buffy white, with conspicuous dark-brown stripes; a small tuft of feathers above hind toe.

Length, 13.75-17.00; wing, 12.00-13.00; tail, 5.75-6.10. (Fisher).

RANGE.—Nearly cosmopolitan; in America from southern South America to Arctic Ocean. Breeds from Kansas, Indiana and Ohio, southern Oregon, northern Maine. Winters chiefly south of northern boundary of United States.

Nest, on ground in marsh, meadow or prairie, of grass and sticks.
Eggs, 4-7; white or creamy white; 1.59 by 1.23.

Resident in some numbers northward; elsewhere irregular winter resident in varying numbers. Some winters not seen. Occasionally very abundant.



Short-eared Owl.

(Merriam. -Annual Rept. U. S. Department of Agriculture, 1888, p. 496.)

Their original home was the prairie. Therefore, we may expect to find it most often in the area of original prairie land. It seems to prefer the long, rank grass about marshes, and in such localities it breeds. About May 6, 1890, two nests of the Short-eared Owl were found at English Lake. They were built in large grass tussocks in the open meadow. One contained three young and two eggs; the other, three eggs (Deane). Since the forest area has so largely given place to meadow, pasture and small grain, where prairie animals and insects

have come, it is to be expected that these owls will visit it to a greater or less extent. They irregularly range over it in greater or less numbers, sometimes in flocks of from seven to twenty-five in winter. They take up their quarters in our meadows, and all winter long wage a relentless war upon the mice, shrews and other four-footed pests. Their coming is evidently regulated by the food supply, for always when they come in force the meadows are overrun with mice.

In the Whitewater Valley Dr. Haymond never recognized it. The first specimen taken there was November 8, 1878. From that time to 1886 no more were seen. The winter of 1883 they were tolerably common in Rush County. Prof. W. P. Shannon obtained six specimens from a flock there. In November and early December, 1886, they came in immense numbers, in company with other Owls and several Hawks, and ranged over Indiana and Ohio to their southern boundary. In some places they are reported in flocks of ten to twenty-five. Near Cincinnati Dr. Langdon notes that during February, 1887, a young man who was crossing a partially inundated field counted these birds as they arose before him, and at one time there were thirty in the air. There was only one tree in the field, upon which they all alighted. (Jour. Cin. Soc. Nat. Hist., Vol. XII, 1889, p. 59.)

In Franklin County, Indiana, they were very common throughout the county. Every one was speaking about the Prairie Owls. In one neighborhood in Decatur County there were three flocks, and another two, with from ten to twenty-five owls each. It is estimated there were hundreds of these birds in that county that winter (Shannon). A great many were seen in January, 1887, in Fayette County (Rehme). The same winter they were common in Knox County (Chansler), and were reported from Vigo (Evermann). They remained in the spring of 1887 well into April. The last one noted in Franklin County was April 26. Wherever they were observed their great destruction of mice was noted. In the winter of 1890 they were very common in Clinton County (Evermann). In 1892 a large number were killed in Knox County (Chansler). The winter of 1894-5 they ranged as far as Putnam County, where a small flock was found (Earlle). The stomachs of ten of those taken the winter of 1886-7 showed that one was empty and nine contained the remains of mice. A summary of 101 stomachs examined shows that 11 contained small birds; 77, mice; 7, other mammals; 1, insects, and 14 were empty. (Dr. Fisher, Bull. No. 3, Div. of O. and M., U. S. Dept. Agr.).

Fully 75 per cent. of its food consists of mice, no less than six having been found in one stomach. In addition to their mousing habits, their habit of wandering and appearing in localities where mice



Fisher, Year Book, U. S. Dep. Agr., 1894.

BARRED OWL.

have become so numerous that they could not be overcome by ordinary means, is one of great importance, and renders them chiefly benefactors to the farmers. Their presence in unusual cases in times of great emergency adds much to their value of service to man. In cloudy weather they may often be seen hunting their food by day. Their eggs are laid in April and May, in nests in such situations as have been mentioned at English Lake. They require about three weeks to hatch. But one brood is raised a year.

82. GENUS SYRNIUM SAVIGNY.

148. (368). *Syrnium nebulosum* (FORST.).*Barred Owl.**

Large size; no ear tufts; general color, umber-brown and buffy whitish; the plumage everywhere barred transversely except on the belly, where the stripes run lengthwise; bill, yellow; eyes, brown-black.

Length, 19.00-24.00; wing, 12.50-14.00; tail, 9.00-10.00. (Fisher).

RANGE.—Eastern North America, west to Dakota and Kansas from Texas and Georgia; north to Manitoba and Nova Scotia. Breeds throughout its range. Resident except at the extreme northern portion of its range.

Nest, in hollow trees or in deserted large birds' nests. *Eggs*, 2-4; pure white; 1.94 by 1.65.

Common resident. Breeds. Not so common as it was formerly, and apparently not so numerous in the Whitewater Valley as elsewhere. The following references to counties will give some idea of its numbers: Knox, common resident (Chansler); Porter, common along the Kankakee River; quite rare in Cook County, Illinois (Parker); Starke, common (Deane); Carroll, the most abundant owl (Evermann); Monroe, quite common (Blatchley); Dekalb, common resident (Mrs. Hine); Lake, rather common at Water Valley (Aiken); Wabash, quite abundant resident (Ulrey and Wallace); Brown, rather common (Kindle).

This is the common large muley owl—the big woods owl that has no horns or ears. It is commonly known as the “Hoot Owl,” on account of its well-known hooting, which Mr. Robert Ridgway interprets “Who-who-who-who-who-who-who-r-r-e-you?” although sometimes translated as “Who cooks for you all?” “This call is far louder than the deep bass hooting of the Great Horned Owls, and is also more varied. Frequently it is preceded by a very loud, blood-curdling shriek, causing the hair of the uninitiated to rise on his head and his knees to tremble for fear that a panther is prowling in the neighborhood. When several get together their nocturnal concerts are very

entertaining. One appears to tell some joke or do something funny, at which the rest set up a hearty though demoniacal he, he, he, hi, hi, hi, hi, ha, ha, ha, ha, and the uncanny company is boisterously hilarious for a few moments, when the solitude of the night again reigns supreme." (Birds of Illinois, I, pp. 409, 410.)

Mr. F. M. Chapman says: "The usual call is a sonorous 'Who-who-who, who-who, to whoo-oh.'" (B. E. N. A., p. 216.)

They begin mating in February, and some years may lay that month, though it is usually in March. The nest is in the hollow of a tree; or when that is not convenient, in an abandoned crow's or hawk's nest. The female appears to incubate the eggs, which requires from three to four weeks. Unless the eggs are taken, but one brood is raised.

They may be seen abroad on sunless days, and then usually receive much notice from crows and other birds, which collect to persecute them. Mr. H. K. Coale informs me of an unique instance of this. June 15, 1884, in Starke County, Indiana, he came upon a Barred Owl in a high tree. It was being attacked by the following birds: Wood Thrush, Blue Jay, Gnat-catcher, Great Crested Fly-catcher, Red Start and Yellow Warbler, all calling and flying at it. Mr. H. W. McBride kept a pair until they were a year old, but they did not breed.

Occasionally the Barred Owl eats a chicken, but this is not common, and perhaps most frequently when snow covers the ground in winter. The examination of the stomachs of these owls, made under the direction of Dr. C. Hart Merriam, shows that of 109 examined 5 contained poultry or game; 13, other birds; 46, mice; 18, other mammals; 4, frogs; 1, a lizard; 2, fish; 14, insects; 2, spiders; 9, crawfish, and 20 were empty. (Bull. No. 3, Div. O. and M., U. S. Dept. Agr., p. 156.) But about 4½ per cent. of its food is poultry or game, and this is doubtless mostly obtained from fowls roosting in trees or exposed places. By far the bulk of their food is composed of injurious animals, the principal part of which is mice. We are disposed to wage war upon them for the occasional pullet they destroy and consider not the ten destructive mice of which they rid us.

83. GENUS SCOTIAPTEX SWAINSON.

149. (370). *Scotiaptex cinerea* (Gmel.).

Great Gray Owl.

Largest of our Owls. No ear tufts. Wing, 16.00-18.00; bill, small, nearly hidden by feathers; eyes, yellow; general color, dusky grayish-brown and grayish-white.

Length, 25.00-30.00; tail, 11.00-12.50. (Fisher).

RANGE.—Northern North America; south in winter to northern border of United States, casually to southern New England, New Jersey, Ohio, Illinois and southern Montana and California. Breeds from Hudson Bay territory and Washington State throughout the northern timber area.

Nest, of sticks, lined with feathers, in trees. *Eggs*, 2-4; dull white; 2.16 by 1.71.

Accidental visitor in winter. From the northern part of the State it has been reported by Dr. A. W. Brayton, and Mr. E. R. Quick has noted it in Franklin County, where it was captured several years ago. It has been reported from Ohio, Michigan and Illinois also. Its home is far north. Mr. E. W. Nelson says it is a common and well-known resident throughout all the wooded parts of Alaska, and thence south to Washington Territory (N. H. Coll. Alaska, p. 150). From there it ranges into the Anderson River district and throughout the Hudson Bay country.

84. GENUS NYCTALA BEHM.

*150. (372). *Nyctala acadica* (GMEL.).

Saw-whet Owl.

Synonym, ACADIAN OWL.

Smallest Owl of the eastern United States; no ear tufts; wing, less than 6 inches; tail, less than 3.50 inches; above, brown, more or less spotted with white; beneath, white, striped with reddish-brown.

Length, 7.25-8.50; wing, 5.25-5.90; tail, 2.80-3.25. (Fisher).

RANGE.—North America eastward, from Carolinas and Kentucky north to Hudson Bay. Westward it ranges south along the mountains to Oaxaca, Mex. Breeds from central Indiana, New York and Massachusetts, New Mexico and Arizona northward.

Nest, in hollow tree, Woodpecker's hole, occasionally in open, deserted nest. *Eggs*, 3-7; pure white; 1.19 by 1.00.

Not uncommon resident northward; irregular winter resident south. Some winters rather common locally. Occasionally little parties or families are found in a locality, and it is very interesting to note the precision with which one will occupy a certain perch, and if it is taken, another will take its place. In the vicinity of Chicago it seems tolerably numerous. Mr. Nelson mentions over a dozen having been taken within two years (Bull. Essex Inst., Dec., 1876, p. 117). Mr. H. K. Coale reports from that general locality thirty specimens within ten years (Ridgway, B. of I., Sec. 7, p. 414). Mr. B. T. Gault took a specimen in a grove at Sheffield, Lake County, Indiana, June 14.

1889; another, June 28. They were in the juvenile or *albifrons* stage. He thinks they undoubtedly were raised there. In Boone County, Mr. J. E. Beasley says, it occurs both summer and winter. Prof. B. W. Evermann thus gives an account of its nesting in Carroll County, May 8, 1883: "In an old thicket near Burlington I found six young *Saw-whets* in a hole in a dead elm. The hole was about twenty feet from the ground, and the young Owls were able to fly." He adds he has heard it at various times in the spring. (The Auk, Oct., 1888, p. 351.) This is the most southerly record of its nesting (Bendire, L. H. N. A. B., I, p. 350).

The winter of 1886-7 they seem to have been generally distributed over the State. Dr. A. W. Brayton informs me that winter they were rather common in Indianapolis. The fall of 1894 Mr. Jesse Earlle found them near Greencastle. The following summary of his notes is given. November 10 found one so tame he caught it in his hands. November 26 saw another, but failed to catch it. It was in the identical place where he caught the first one. It had brownish eyes. November 27 found one, a male, dead, on the railroad, about a mile from where he found the others. December 15 saw two; caught one, which was at the same place where first was taken, in a butterfly net. One of these was probably the same one seen November 26, as its eyes were similar. December 17, caught the remaining one, with brownish eyes, a female. He tried to keep this and the first one taken, alive, but after about a month they died. They have been reported from the following additional counties: Franklin, April 29, 1883 (Haymond); Tippecanoe (Dr. E. Test); Allen, rare (Stockbridge); Dekalb (R. W. McBride, Snyder); Fayette, January 10, 1887 (Rehme); Monroe, November, 1886 (Evermann); Wabash, November 20, 1894 (Ulrey and Wallace).

The Saw-whet Owl is decidedly nocturnal. It seems totally blinded and helpless in bright daylight. It is the smallest Owl found within this State. The absence of tufts on its head renders it easily distinguishable from the Screech Owl. They usually nest in cavities in trees, sometimes, perhaps, beginning in April and continuing through May. It is thought that both sexes assist in incubation. The note of this Owl is rasping, reminding one somewhat of the sound made by filing a cross-cut saw. From this it derives its name. Of 22 stomachs examined, 17 contained mice; 1, a bird; 1, an insect, and 3 were empty. (Dr. Fisher, Bull. No. 3, Div. O. and M., U. S. Dept. Agr., p. 162.) Its favorite food is mice, and it is friendly to all whom the mice despoil.

85. GENUS MEGASCOPS KAUP.

151. (373.) *Megascops asio* (LINN.).*Screech Owl.****Screech Owl.**

"Toes more or less distinctly feathered or bristled on upper side; ear tufts conspicuous; plumage presenting two totally distinct phases, having no relation to sex, age or season, one grayish, the other bright rufous; a more or less conspicuous bright colored stripe runs along each side of the back and a blackish line along the shafts of the feathers, sometimes throwing out transverse bars.

"Length, 6.50-10.00; wing, 5.60-7.10; tail, 3.00-3.70." (Fisher).

RANGE.—Eastern North America, from Texas and Georgia to Lake Superior and New Brunswick, west to South Dakota and Kansas. Generally resident throughout its range.

Nest, in hollow trees or in old buildings. *Eggs*, 4-7; white; 1.42 by 1.19.

Resident; abundant; breeds. Everywhere the little Screech Owl is a well-known bird. Sometimes it is seen in gray plumage, but at this time in Indiana it is more often seen in the red phase. People formerly thought each color represented a different bird and that we had

two kinds of Screech Owls, one red, the other gray. The fact is, the color is independent of age, sex or season. This double-color phase is called dichromatism.

In Indiana, in the Wabash Valley, 95 per cent. of the Screech Owls have been found to be red (Ridgway). From the Miami Valley of Ohio and the Whitewater in Indiana about 60 per cent. were found to be red (Langdon, Jour. Cin. Soc. N. H., April, 1882, pp. 52-3). In the winter of 1886-7, in Franklin County, Indiana, red Screech Owls were abundant and gray ones exceedingly rare. Up to 1882 almost all seen were gray, and prior to 1886 red Screech Owls were rare. At Terre Haute and at Bloomington, Carroll County, red is the prevailing phase. But it had not always been so. Prof. B. W. Evermann in 1890 said: "In 1877-'79 we got a good many Screech Owls at Camden, perhaps twenty all told, and I think there were only four or five red ones. Since 1885 I have seen four or five at Burlington, all red. In Wabash County both the red and gray phases are abundant. Since 1886, at Terre Haute, I have seen perhaps fifteen or twenty, and only three or four of them were gray. In 1891 Miss Bessie O. Cushing (Ridgely) secured three red Screech Owls at Peru." In Lake County, in 1886, Mr. L. T. Meyer said the gray form predominated. Mr. E. M. Hasbrouk has given us the result of his studies of this problem (*American Naturalist*, Vol. XXXII, p. 521, etc., 1893), from which I make a few notes:

There are places where only the gray is known. There is at least one place, from the neighborhood of the mouth of the Ohio River southward to Louisiana, where only the red form prevails, while between the two areas are found both red and gray. The State of Indiana is in this belt, and the greater part of it is in that portion where the red form predominates. All records show that the offspring of a pair of gray birds are invariably gray. •On the contrary, the young of a pair of red birds, or a pair of which one is of each color, red and gray, may be part of one color and part of the other.

To the mind of the author all this presents a nice little study in evolution, in which he has discovered humidity, temperature, acquired characters and forest area are important factors. Mr. Ridgway had previously suggested humidity as one cause. (*Proc., U. S. Nat. Mus.*, 1878, p. 108).

Mr. John Wright, a relative, living in Bartholomew County, told me in the summer of 1897 of some Owls that lived in or near a bridge in that county that attacked a number of persons who attempted to cross the bridge after night. They had attacked him. They were small Owls, he said, and he thought they were this species.

They nest in cavities in trees, an old apple tree in an orchard being a favorite place, in old squirrel nests and old buildings. Eggs are laid in May or early June. Incubation is thought to last about three weeks, beginning with the time the first one is laid. Eggs are deposited every two or three days.

These owls are much more numerous about our towns than they were formerly. English Sparrows have become numerous, and the Screech Owls have found them to be good eating and easily obtained. They keep the number of Sparrows down. In fact, the Sparrows are not nearly so common now as they were a few years ago. The owls are quite nocturnal, sitting through the day with eyes closed, and by approaching carefully, they may often be taken by hand. March 26, 1887, I caught one alive on his perch on the lower limb of a small beech tree. The perch had long been occupied, for there was a great quantity of ejected material below the place where it sat. Amongst the refuse I identified the skull of the following: Mice, *Synaptomys cooperi*, *Arvicola riparius*, *Calomys americanus*; fragments of beetles, cicadae and crawfish. Its stomach contained the remains of a shrew. A specimen sent me by Mr. E. L. Guthrie, Adams, Ind., contained 3 crawfish and one minnow. There is no other record of this Owl eating fish. A specimen taken at Brookville, December 31, 1887, had eaten a quantity of butter. Of 255 stomachs reported upon from the United States Department of Agriculture, 1 contained poultry; 38, other birds; 91, mice; 11, other mammals; 2, lizards; 4, batrachians; 1, fish; 100, insects; 5, spiders; 9, crawfish; 7, miscellaneous; 2, scorpions; 2, earthworms; and 43 were empty (Bull. No. 3, Div. O. & M., U. S. Dept. Agr., p. 173). Birds were found in about 15 per cent., fully one-third of which were English Sparrows.

Throughout the warmer parts of the year insects form quite a large part of its food. "As nearly three-fourths of the Owl's food consists of injurious mammals and insects, and only about one-seventh of birds (a large portion of which are destructive English Sparrows), there is no question that this little owl should be carefully protected" (Dr. A. K. Fisher, Year Book U. S. Dept. Agr., 1894, p. 226).

86. GENUS BUBO DUMERIL.

152. (375). **Bubo virginianus** (GMEL.).

Great Horned Owl.

Large and heavy. Ear tufts very conspicuous. Plumage, irregularly varied with buffy, tawny, whitish, and dusky, one or other of the colors predominating in the different races. The buffy and tawny

tints are most marked in the typical bird, the dusky in the dusky Horned Owl, and white in the Arctic bird.

Length, 18.00-25.00; wing, 14.50-16.00; tail, 8.25-9.00. (Fisher).

RANGE.—Eastern North America, from Costa Rica to southern Labrador and eastern Manitoba. Winters to central Texas and middle Kansas. Resident throughout most of its range.



Great Horned Owl.

(Fisher.—Year Book United States Department of Agriculture, 1894, p. 228.)

Nest, usually in hollow tree, or deserted nest of other large bird.
Eggs, 1-5, usually 2 or 3; white; 2.12 by 1.81.

Common resident. Breeds. In southeastern Indiana this is the most common large Owl. In some other portions of the State it is not so numerous as the Barred Owl, but everywhere it is common. Frequents mostly deep woods. It is commonly called "Cat Owl" or the "Big Long-eared Owl," to distinguish it from the Long-eared Owl (*Asio*

wilsonianus), which is termed "Little Long-eared Owl." This Owl is nocturnal in its habits. Occasionally it is seen abroad on a cloudy day. Then it becomes the target for the attacks of Crows, Kingbirds and other birds. The excited cawing of a lot of Crows on such a day often indicates that an Owl is abroad.

Mr. F. M. Chapman says: "Its usual call is a loud, deep-toned Whoo, hoo-hoo-hoo, whooo, whooo. The syllables are all on the same note, and bear some resemblance to a bass-voiced dog barking in the distance. A much rarer call is a loud, piercing scream, one of the most blood-curdling sounds I have ever heard in the woods." (Birds E. N. A., p. 220.)

Mating begins in January and continues through the next month. They lay their eggs in the nests of Hawks and Crows and in hollow trees. Prof. A. J. Cook records one instance of the Great Horned Owl and Red-tailed Hawk occupying the same nest at different times. This had been kept up for years, the former using it in February, the latter in April (Birds of Mich., p. 83). They usually lay their eggs in February, sometimes by the first of the month. Major Bendire thinks about three days elapse between the laying of each egg, and that about 28 days is the incubation period. The female, he thinks, performs that duty. Mr. H. W. McBride has raised several, and says he finds it impossible to tame them. He took young Owls, March 14, 1890. Mr. Chas. Barber found a nest near Laporte, March 11, 1892. March 26 he first examined it; then it contained two young, covered with white down. Before the young was piled parts of two rabbits, two rats and two mice; all quite fresh. The Crows had been constantly and persistently bothering the old ones. April 9, one died; April 11, the white downy covering nearly all had disappeared. Bill, cere, and toenails, black; wing-quills, $2\frac{1}{2}$ inches long, with tuft of feathers at end; feathers, variegated, yellow and black. From the first, seemed afraid of him. Occasionally pairs may be found breeding most any time in summer as late as October. Mr. F. M. Noe had a half-grown Owl brought to him at Indianapolis, December 1, 1891.

This large Owl destroys more poultry and game than any other of our Owls. This may be largely due to the fact that individuals seem to have a great preference for this kind of food and become unusually destructive. Mr. E. J. Chansler informs me that he lost 59 young Guineas one fall by them. To balance this, sometimes they seem determined to live upon rats. Mr. Chas. Dury records that the remains of 113 Norway rats, most of them with the heads split open and the brains removed, were found in and about a nest of these Owls, which

was in a sycamore stub near a farmer's barn (Journ. Cin. Soc. N. H., April, 1885, p. 66).

Rabbits are the principal mammals eaten, though they are great destroyers of mice. They also eat muskrats, opossums and skunks.

The summary of 127 stomachs examined shows that 31 contained poultry or game birds; 8, other birds; 13, mice; 65, other mammals; 1, a scorpion; 1, fish; 10, insects; and 17 were empty. (Fisher, Bull. No. 3, Div. O. & M., U. S. Dept. Agr.) Undoubtedly almost all the poultry eaten by the Great Horned Owl is taken from fences, trees and other exposed perches, where many farmers permit their fowls to roost. If they will take care to have them properly housed, the Owls will seldom bother them. The farmer who takes proper care of his poultry has no charge to make against this Owl. To all such it is a beneficial bird. To the fruit growers, by reason of its destruction of rabbits and mice, it is a true friend. Let it be protected accordingly.

87. GENUS NYCTEA STEPHENS.

153. (376). *Nyctea nyctea* (LINN.).

Snowy Owl.

"Ear tufts, rudimentary; plumage, pure white, sometimes almost unspotted, but usually marked more or less with transverse spots or bars of slaty-brown.

"Length, 20.00-27.00; wing, 15.50-18.75; tail, 9.00-10.30." (Fisher).

RANGE.—Northern part of Northern Hemisphere. In North America breeding from Labrador, Hudson Bay and north Alaska, northward. South, in winter, to Ohio Valley; casually to South Carolina, Texas, California and Bermudas.

Nest, a few feathers, or bits of moss, in a depression on a knoll. *Eggs*, 3-10; white; 2.24 by 1.76.

Winter visitor, of irregular occurrence. Most every winter it is seen. Usually it is rare, but occasionally it appears in some numbers. In the northern part of the State it is seen more often than elsewhere. There are but few records from the Whitewater Valley. A specimen taken in Franklin County, in December, 1879, is in the collection of Mr. E. R. Quick, of Brookville. The winter of 1886-7 one was seen north of Brookville, and one was taken at Cedar Grove, December, 1893. In Fayette County one was taken, February 18, 1887 (Rehme), and in Wayne County one was reported during the holidays, 1887 (F. M. Smith). The winter of 1885-6 several were reported from different parts of the State, and in the winter of 1886-7 they were still more nu-

merous and were generally distributed. They were again observed over the northern part of the State in 1889-90. The earliest appearances are early in November, and most of them are generally seen in that month and December. Usually they are gone in February, though one was reported from Valparaiso, March 31, 1887 (Trouslet); and Mr. C. E. Aiken informs me of one observed "about May," 1870, in Lake County. Besides a lot of general records, I may mention the following, from the counties named: Carroll, 1865 (Evermann); La-



Snowy Owl.

porte, Michigan City, December 21, 1883 (Miss Colfax); Lawrence, near Bedford, 1887 (Chansler); Chicago, Ill., two, November 3, 1885 (Parker); Porter, two, winter of 1885-6; one prior to that (Trouslet); 1st of November, 1887 (Byrkit); Decatur (Guthrie); 2 taken, several others seen, winter of 1886-7 (Shannon); Putnam, 1888 (Clearwaters); Vigo, November 20, 1889; Olivet, Mich., December 2, 1889, near White Pigeon, Mich., 1889 (Evermann); Allen, one, winter of 1889-90 (Stockbridge); Tippecanoe, February 20, 1891 (Moffitt); Wabash, near Roann, one, probably winter of 1891-2, one, near North Manchester, winter 1893, and one in 1894 (Ulrey and Wallace); Marion, near Southport, November, 1894 (Noe); one also taken at Sandusky, O., November 26, 1896 (Moseley).

Although they are with us only occasionally, their visits are bene-

ficial. Their chief food, with us, is meadow mice; in the Arctic regions these mice and lemmings principally supply its wants. Mr. L. M. Turner, in his "Notes on the Birds of Labrador and Ungava," says: "It never seizes its prey except while the latter is in motion, except in the case, probably, of fish." The examinations of stomachs conducted by the United States Department of Agriculture show, of 38 stomachs of the Snowy Owl examined, 2 contained game birds; 9, other birds; 18, mice; 2, other mammals; and 12 were empty. (Fisher, Bull. No. 3, Div. O. & M., U. S. Dept. Agr., p. 187.)

The beauty of the plumage of this useful bird marks it for slaughter. It flies by day, and is, therefore, very conspicuous. Few, if any, of those that visit the United States live to return. The winter of 1876-7, Mr. Ruthven Deane estimates as many as 500 were killed in New England.

Audubon gives an interesting account of the fishing habits of this Owl, as observed by him at the Falls of the Ohio (Orn. Biog., Vol. II, p. 136).

88. GENUS *SURNIA* DUMRILL.

154. (377a). *Surnia ulula caparoch* (MÜLL.).

American Hawk Owl.

"No ear tufts; tail rounded at tips, and indistinctly barred with white. Top of head and back of neck, spotted with white and black, or dark brown; a patch of uniform blackish or dark brown on each side of hind neck; upper parts, brown, more or less spotted with white; lower parts, regularly barred with brown.

"Length, 14.75-17.50; wing, 7.50-9.00; tail, 6.80-7.00." (Fisher).

RANGE.—Northern North America. Breeds from Newfoundland and Manitoba, northward. South, in winter, irregularly, to northern United States; Massachusetts, Ohio, Indiana, Illinois, Minnesota, Dakota and Montana.

Nest, in natural cavity, in tree or among limbs of bushy conifers. *Eggs*, 3-7; white; 1.51 by 1.23.

Accidental visitor. Mr. E. R. Quick identified it in Franklin County, in January, 1878.

This Owl is diurnal in its habits. It hunts by day, generally in the morning, or in evening. It nests from Newfoundland northward to the Arctic regions, wherever timber is found. Nelson says: "This is perhaps the most abundant resident bird of prey throughout the entire wooded part of northern Alaska." (N. H. Coll. in Alaska, p. 155.) The Hawk Owl has been taken in the lower peninsula of Michigan, the

last being in 1891 (Cook, Birds of Mich., p. 84). It has been noted in Ohio (Wheaton, Birds of Ohio, p. 414), and one record is known from Illinois. It was taken in Kane County by Dr. J. W. Velie the 1st of September, 1869 (Bull. Essex Inst., Vol. VIII, 1876, p. 117). This Owl is classed among those that are principally beneficial. Incubation begins as soon as the first egg is deposited, and both sexes share in the work (Bendire).

K. ORDER PSITTACI. PARROTS, MACAWS, PAROQUETS, ETC.

XXIX. FAMILY PSITTACIDÆ. PARROTS AND PAROQUETS.

*a*¹. Middle tail feathers longest.

CONURUS. 89

89. GENUS CONURUS KÜHL.

*155. (382). *Conurus carolinensis* (LINN.).

Carolina Paroquet.

Adult.—Rich grass-green, varying to emerald in some lights, the lower parts lighter and more yellowish-green than the upper; tertials, tips of greater coverts, and basal portion of primaries, greenish-yellow; primaries, dark blue at tips; forehead, lores and cheeks, rich orange-red, or orange-crome; rest of head, with upper part of neck, pure gamboge-yellow; edge of wing, tinged with orange; bill, creamy-white; eyelids, whitish; iris, blackish-brown; feet, whitish. *Immature*.—Similar, but no yellow on head or neck, which are green; the forehead only, or the forehead and lores, dull orange-red.

Length, 11.35-14.00; wing, 7.00-7.60; tail, 6.40-7.10.

RANGE.—Formerly eastern United States, from Florida and Gulf coast north to Denver, Col., northern Nebraska, Iowa, northern Illinois, southern Michigan, to Albany, N. Y. Now, probably only found locally in Florida and perhaps Indian Territory. Said to breed in cavities, in trees, and also to build nests among the branches.

Eggs, 2; white; 1.39 by 1.07.

Formerly resident; found throughout the State; now extinct. Bred at least north to the vicinity of Indianapolis.

This beautiful little Parrot is now almost extinct. It will soon be entirely exterminated. At present it is probably to be found in small numbers in Florida and in a few favorable localities from there to northeastern Texas and Indian Territory.

Less than a century ago they reached north into Michigan, thence east to Albany, N. Y., and west into Colorado. In 1806 they reached the mouth of the Manimee (Maumee) in Ohio (Audubon) and probably the northern line of this State. R. Kennicott took specimens in the vicinity of Chicago, and Dr. H. M. Bannister saw it there (Nelson). They were seen at Madisonville, near Cincinnati, O., as late as 1840 (Langdon). Audubon says, in 1842, few were to be found higher than Cincinnati.

In the Whitewater Valley, in 1835, they were last reported from Brookville, Ind. They were common in Switzerland County in 1838-9 and were last noted in Clarke County in 1844. From the other counties named the last record I have been able to obtain is as follows: Vermillion, 1844; Parke, 1842; Marion, 1835; Monroe, 1836; Morgan, 1838-40; Owen, 1845; Greene, 1849; Martin, 1845; Knox and Daviess, 1857-8; Posey, 1858; and the latest date is Knox County, 1859.

Thus it will be seen they disappeared from all of Ohio and Indiana, except the lower Wabash Valley, by about 1840. Their range continued to diminish; it is still growing less. There are persons now living from 80 to 90 years of age in this State who can remember when they were to be found in great numbers over more than one-half of the southern part of Indiana. It will not be surprising if they should live to hear that the Paroquets are extinct.

They preferred the valleys of streams and the vicinity of ponds. There they were found in flocks ranging from six to a hundred or more. In such places grew, in quantities, their favorite food, the "cockle-burr" or "cuckle-burr" (*Xanthium canadense* Müll.). For these it is said they would leave any other food. Sometimes they would gather—numbers of them—upon a stump and shell out the kernel, leaving instead a pile of empty burrs. Wherever they were found, the universal testimony is, they preferably ate this food. Next to cockle-burrs they preferred hackberries.

In spring they were very destructive in orchards, eating the leaf-buds, blossoms and young fruit. Early apples were often eaten. In fall they fed upon apples, grapes and grain. They also ate cherries, persimmons, black-gum berries, haws, beechnuts, acorns, and pecans. One authority says they split open the apples and ate the seeds, discarding the remainder of the fruit. Sometimes, when in large flocks, they seemed bent upon mischief. Then they destroyed an entire crop of fruit. After eating what they wanted they would tear the apples off the tree, and, after taking a bite, throw them to the ground. They also tore off the heads of wheat and threw them upon the ground.

It is always difficult for those who have not seen a part of the changes that the last century has wrought in the Ohio Valley and Lake Region to comprehend what has occurred. The Paroquets were found there in great numbers. Dr. Rufus Haymond, who wrote the first record of their occurrence in the interior of Indiana, in 1856, said: "This bird was formerly very numerous along the Whitewater River. Several years have elapsed since any of them have been seen." Proc. Phil. Acad., November, 1856, p. 293.) Wilson found them in 1810, in flocks, near Lawrenceburg, and in great numbers at the Big Bone Lick, in Kentucky, but a few miles away. When my father was a boy, six or eight years old, about 1816-18, they were common about Brookville. They were quite numerous in Morgan County in 1835-40. Prof. E. T. Cox informs me that they were as numerous about New Harmony in 1826 as Blackbirds (*Quiscalus quiscula æneus*) are now. Several others have given the same estimate of their numbers.

Another authority says they alighted upon an apple tree in such numbers as to almost cover it over. They flew in two lines converging to a point, in form resembling the figure made by a flock of Wild Geese (*B. canadensis*). While on the wing they chatter and cry continually. This cry sounds like *qui*, with rising inflection on the *i*. This is repeated several times, the last one being drawn out like *qui-i-i-i* (Nehrling, N. A. B., XVI, p. 439).

The older people all claim they roosted and nested in cavities, natural or otherwise, in trees. Prof. John Collett has supplied me with the following note: "In 1842, Return Richmond, of Lodi (Parke County), Ind., cut down, in the cold weather of winter, a sycamore tree some four feet in diameter. In its hollow trunk he found hundreds of Parakeets in a quiescent or semi-torpid condition. The weather was too cold for the birds to fly or even to make any exertion to escape. Mr. Richmond cut off with his saw a section of the hollow trunk some five feet long, cut out a doorway one foot by two in size, nailed over it a wire screen of his fanning mill, rolled this cumbersome cage into the house and placed in it a dozen of the birds. They soon began to enjoy the feed of fruit, huckleberries and nuts he gave them, and he had the pleasure of settling absolutely the disputed question of how they slept. At night they never rested on a perch, but suspended themselves by their beaks, and with their feet on the side of their cage. This was repeated night after night during their captivity."

Mr. W. B. Seward, of Bloomington, informs me of obtaining some five, he thinks, young Paroquets from a farmer's boy in Owen County, in 1845. His impression is they were taken from the inside of a hol-

low tree, on the borders of White River. This is the farthest north we have any account of their nesting.

Audubon, Wilson and others say they nested in hollow trees. In 1889, while making explorations in Florida, Mr. William Brewster made every inquiry he could concerning the breeding habits of these birds. There he was informed they built nests like those of a Carolina Dove, in the forks of small cypress trees. It is possible that both kinds of sites were selected. The number of eggs is unknown, but has been given as from two to five.

They are easily tamed and make interesting pets. In their wild state they are very affectionate. It is said when one of a flock was wounded the others gathered about, regardless of danger, and made every effort to render the cripple assistance.

The following papers treat of this subject more extensively and are referred to for the benefit of any who care to investigate it further: The Carolina Paroquet (*Conurus carolinensis*), by Edwin M. Hatcher (The Auk, Vol. VIII, October, 1891, pp. 369-379). Notes on the Range and Habits of the Carolina Parakeet, by Amos W. Butler (Ibid, Vol. IX, January, 1892, pp. 49-56).

L. ORDER COCCYGES. CUCKOOS, ETC.

SUBORDER CUCULI. CUCKOOS, ETC.

XXX. FAMILY CUCULIDÆ. CUCKOOS, ANIS, ETC.

SUBFAMILY COCCYGINÆ. AMERICAN CUCKOOS.

- α¹. Tail feathers 10; bill gently curved downwards; colors of plumage soft and blended; wing less than 6.00; tail less than 8.00. COCCYZUS. 90

90. GENUS COCCYZUS VIEILLIOT.

- α¹. Tail feathers except middle pair black with white tips; lower mandible yellow. C. americanus (Linn.). 156

- α². Tail feathers grayish brown, with narrow tips of dull whitish; lower mandible not yellow. C. erythrophthalmus (Wils.). 157

*156. (387). *Coccyzus americanus* (LINN.).

Yellow-billed Cuckoo.

Synonyms RAIN CROW, COW-COW.

Bill, extensively yellow below, except tip; above, glossy black; central tail feathers, like the back; above, uniform satiny olive-gray, with bronzy reflections; below, pure white; wings, extensively rufous on inner webs of the quills, the rest black, with large white tips, the outermost usually edged with white.

Length, 11.90-12.70; wing, 5.40-5.80; tail, 6.00-6.15.

RANGE.—Eastern North America, from Costa Rica and West Indies northward to New Brunswick, southern Ontario, and Minnesota. Breeds from Florida and east Texas northward. Winters south of United States.

Nest, a mere platform of twigs, in bushes or in trees, 4 to 20 feet up. *Eggs*, 2-5, rarely 6 or 7; light greenish-blue; 1.21 by .88.



Yellow-billed Cuckoo.

(Bent.—Farmers' Bulletin 54, United States Department of Agriculture.)

Common summer resident; less numerous northward. Arrives usually early in May. Southern Indiana spring arrivals show as dates first observed: April 23, 1887, May 9, 1893 (Greensburg); April 30, 1895 (Bicknell, Knox County); May 3, 1888 (Vincennes); April 29, 1894, May 3, 1893 (Spearsville, Brown County). Northern Indiana: Lafayette, May 8, 1897; Dekalb County, Sedan, May 11, 1894, May 6, 1895; Waterloo, May 3, 1896, May 6, 1897; Laporte, May 15, 1894, May 10, 1895, May 6, 1896. The following fall records indicate when the last bird was seen. In 1889 the last one remained at Sedan until October 13, and in 1894 the last one was noted at Plymouth, Mich., September 3. In 1896 the last one was noted at Lafayette, October 13. In 1895 the last one was seen at Chicago, Ill., September 22; at Lafayette, September 9; at Bicknell, Ind., October 14. The earliest date at which it left Brookville was September 6, 1886, and the latest, October 10, 1884. The last seen in Warren County, in 1897, was September 20. On September 17 old birds were seen feeding their

young. They begin to leave early in August. August 16, 1897, at 9:15 p. m., Mr. Barnett heard one in Vermillion County flying south. They sometimes are pairing when they arrive; again they mate soon after arrival. They are very numerous in May, in southern Indiana—one who has not observed them does not know how plentiful they are. Then they frequent orchards, lawns, and woods. Both species are called Rain Crow, Cow-Cow, and Wood Pigeon.

I have seen them mating May 8 (1886), and as late as June 10 (1893). I have found their nest and eggs by May 20. Prof. B. W. Evermann found a nest, with fresh eggs, June 30, 1885. They build their nests in thick bushes, on ends of low limbs of trees, especially of beech, and wild grape vines, from 5 to 15 feet high. The usual nest is a mere pretense, a flimsy structure of a few sticks, with a few blossoms, generally of the oak, with us, upon which to lay the eggs. Occasionally a very substantial nest is built—one such was found at Bloomington, Ind., by my friend, Mr. O. M. Meyncke. Often eggs are found upon the ground, beneath the nest; either the bird flirts them out as she leaves the nest or they are thrown out as the limb or bush is swayed by the wind. Incubation begins when the first egg is laid. Young birds and eggs in various stages of incubation, some almost fresh, are often found together. This and the next species occasionally lay in each other's nests, also in the nests of other birds. They, however, do not do this habitually, as the European Cuckoo does.

Its common call, that may be heard throughout its stay, is *Cook-cook-cook-cook*; another call is, *Cow-cow-cow-cow*; another is, *Ock-ock-ock-ock*, sometimes changed into *Ke-ock*, *ke-ock*, *ke-ock*, *ke-ock*.

Few birds are of so much service to the farmer. Especially are the fruit growers and nurserymen its debtors. In early spring, they love the orchard. I have known them to destroy every tent caterpillar (*Utsiocompa americana*) in a badly infested orchard, and tear up all the nests in a half day. While they may have eaten some caterpillars, out of most of them the juices were squeezed and the hairy skin dropped to the ground. Almost every watchful fruit grower has had a similar experience. Prof. F. H. King found, upon examination, that one had eaten nine larvæ of a species that destroys the foliage of black walnut trees. They also eat many canker-worms. Of nine specimens dissected by Dr. B. H. Warren, all but one had eaten insects, chiefly taken from shade and forest trees; these were beetles and caterpillars, besides one had eaten grasshoppers and snails (*Helix*), and one had eaten berries. While they occasionally eat some of the smaller fruit, their work all summer long is to protect the fruit tree from its enemies. Although it has been accused of robbing

the nests of other birds, and eating their eggs, I do not believe the charge has been sustained.

The results of the examinations of 21 stomachs of these birds showed that the contents consisted of 355 caterpillars, 18 beetles, 23 grasshoppers, 31 sawflies, 14 bugs, 6 flies and 12 spiders; one stomach contained 12 American tent caterpillars; another, 217 fall web worms. (Beal, Farmers' Bulletin, No. 54, U. S. Dept. Agr., p. 6).

***157. (388). *Coccyzus erythrophthalmus* (WILS.).**

Black-billed Cuckoo.

Adult.—Bill, black; tail like the back and tipped with white; under surface of tail feathers, dull white; eyelids, red. Above, uniform olive gray, with bronzy reflections; below, pure white, sometimes with faint tawny tinge on fore parts; wings, with little or no rufous. *Immature*.—Eyelids, yellow, more grayish above.

Length, 11.00-12.70; wing, 5.12-5.65; tail, 6.25-7.00.

RANGE.—America, from Brazil, Amazon Valley to Labrador, Manitoba and east Assiniboia. West to Rocky Mountains. Breeds from about latitude 35 degrees north. Winters from Florida south.

Nest, similar to that of *C. americanus*, but a little better built. *Eggs*, 2-5, rarely 6 or 7; smaller and darker green than those of last species; 1.11 by .78.

Summer resident; common northward; much less numerous southward, except during migrations, when it is common. It is common north of the Wabash River, and, perhaps, locally farther south. Following 1884, Prof. Evermann thought this species became more common than the last in Carroll and Monroe Counties. We have been accustomed to regard this species as a later migrant than the last. Some years it is, others they come together, and occasionally it is much earlier. I took it at Brookville, April 26, 1892. This is the only record of its arrival in April. In 1893 I did not get it until May 16. In southern Indiana, it may be expected between those dates. In the northern part of the State, the following will give some idea of the date of its first arrival: Lafayette, May 7, 1897; Dekalb County, Sedan, May 11, 1894, May 6, 1895; Waterloo, May 3, 1896, May 14, 1897; Laporte, May 9, 1896.

They leave in August and September, but occasionally one may be seen well through October. At Chicago, Ill., the last was seen September 25, 1895, October 24, 1885; Plymouth, Mich., September 20, 1894; Bicknell, Knox County, Ind., September 16, 1894; Greensburg, September 26, 1896; Warren County, September 23, 1897.

Their mating, nesting and other habits are substantially the same as the Yellow-billed Cuckoo. They build insecure nests, and lay irregularly. A nest may be seen with a fresh egg, one ready to hatch, and a young bird well fledged. Nests may be found from early May well through the summer. A set of eggs in the collection of the United States Museum was taken near Mt. Carmel, Ill., May 7, 1878 (Bendire, L. H., N. A. Birds, II., p. 29). The eggs must have been laid with little time intervening. Usually considerable interval elapses between the laying of each egg, and incubation begins soon after the first one is laid. Sometimes, however, an egg is laid each day. Both sexes incubate. Prof. A. J. Cook mentions four taken at St. Clair Flats, July 20, 1893 (Birds of Mich., p. 86). Mr. J. F. Clearwaters found a nest, containing two fresh eggs, in a willow thicket, near Michigan City, August 13, 1891. Some years most of the birds have left at that date. The nest of the Black-billed Cuckoo is, perhaps, a little more substantial than that of the Yellow-billed. Its eggs are smaller, and a deeper shade of green.

Its food is much the same as that of the last species. Prof. Forbes informs us that 75 per cent. of the food of some he examined contained canker-worms (Rept. Mich. Hort. Soc., 1891, p. 204). Prof. F. H. King says 13 ate 13 hymenoptera, 68 caterpillars, 10 beetles, 26 orthoptera, and 2 harvestmen (Geol. of Wis., Vol. I, 1883, p. 568). Prof. Beal notes that 16 taken during the summer months ate 328 caterpillars, 11 beetles, 15 grasshoppers, 63 sawflies, 3 stink bugs, and 4 spiders (Farmers' Bulletin, No. 54, U. S. Dept. Agr., p. 5). Almost *entirely* do they eat injurious insects, and their work is distinctively beneficial, because they eat so largely of those hairy, destructive caterpillars that other birds do not choose for food. Its common note is a soft coo-coo-coo-coo. In addition, it has other notes, resembling those of the last species.

SUBORDER ALCYONES. KINGFISHERS.

XXXI. FAMILY ALCEDINIDÆ. KINGFISHERS.

Characters same as family.

CERYLE. 91

91. GENUS CERYLE BOIE.

Subgenus STREPTOCERYLE Bonaparte.

*158. (390). *Ceryle alcyon* (LINN.).

Belted Kingfisher.

Adult Male.—Head with crest; above, bluish-gray, with a white collar, wings marked with white. Below, white; band across breast and sides, bluish-gray. *Adult Female*.—Sides tinged with ru-

fous; band across belly, rufous. *Immature*.—Similar to adult, but band across breast and sides tinged with rufous.

Length, 13.50-14.50; wing, 9.10-9.50; tail, 3.80-4.30.

RANGE.—North America, from Panama and West Indies to Arctic Ocean. Breeds from Florida and Texas, northward. Winters from Virginia, southern Indiana, southern Illinois and Kansas, southward.



Belted Kingfisher.

Nest, a burrow in a steep bank, usually near water. *Eggs*, 5-8; pure white; 1.36 by 1.05.

Resident southward, the extent and number depending upon the severity of the winter, and the number of open streams; common summer resident northward. In the northern part of the State, they usually depart late in October or early in November, and return in



Syndactyle foot of Kingfisher.

March and early April. During mild winters, they doubtless remain wherever open water is found. Mr. Jerome Trombley says it is occasionally seen in mild winters in Monroe County, Mich. (Cook, *Birds of Mich.*, p. 86), but in 1897 it was not seen until April 18. One was reported from Dekalb County, February 15, 1888 (H. W. McBride). He also notes it first seen in 1889, March 5. In 1893, it was first

seen in Dekalb County, Sedan, April 5 (Mrs. Hine). At Waterloo, in 1894, March 18; 1896, March 29 (Feagler).

Those living away from water courses and lakes do not know how numerous Kingfishers are, and sometimes persons living along streams think them more common than they are. A pair cover a certain stretch of river, having certain places where they alight and watch for fish. They are very busy, and their loud rattling noise often gives the impression that there are more than the actual number.

I have seen them mating at Brookville as early as March 24 (1893), and as late as April 15 (1887). In April they excavate a hole in a precipitous bank, usually of a water course, and therein deposit their eggs. Sometimes by May 10 a full set is laid. Along the rivers subject to high waters, many of these birds seem to have learned to build in other higher banks; occasionally, however, one builds on the low river banks, and is drowned out. They generally breed in single pairs. Some places they are found in colonies, and the banks are honeycombed with their burrows. Often they and swallows occupy the same bank, even sometimes having a common entrance to their burrows. Dr. F. W. Langdon found, near Cincinnati, O., May 22, 1879, in the same creek bank, the burrows of a Kingfisher and of a Rough-winged Swallow. Each was occupied by the owner. Each burrow was occupied, in addition, by a colony of Bumble Bees, all dwelling in perfect harmony. The Kingfisher was sitting, and would not leave her eggs until taken by the bill and lifted off (Journ. Cin. Soc. N. H., Dec., 1881, p. 338).

The Kingfisher reminds one of a Woodpecker, which excavates holes in banks instead of trees. It lives principally upon fish, although insects are sometimes eaten. The bones, scales and other indigestible portions of its food are ejected in pellets, as is the custom with Owls.

M. ORDER PICI. WOODPECKERS, WRYNECKS, ETC.

XXXII. FAMILY PICIDÆ. WOODPECKERS.

α^1 . Toes 3.	PICOIDES.
α^2 . Toes 4.	
b^1 . Head with a conspicuous crest; size, much over a foot long.	
c^1 . Bill white.	CAMPEPHILUS. 92
c^2 . Bill dark.	CEOPHLEUS. 95
b^2 . Head not crested.	
d^1 . Outer hind-toe longer than outer front-toe.	
c^1 . Upper mandible with three distinct ridges, one in the middle, one on each side; groove from nostrils to near the end of bill; plumage not yellowish below.	DRYOBATES. 93

- c*². Upper mandible with one middle ridge; grooves from nostril running to about the middle of cutting edge of upper mandible; plumage with more or less yellow below. SPHYRAPICUS. 94
- d*². Outer hind-toe not longer than outer front-toe.
- f*¹. Plumage of lower parts spotted with black; under surface of quills and tail feathers yellow or reddish; upper mandible without distinct lateral ridge or nasal groove. COLAPTES. 97
- f*². Plumage of lower parts without spots; under surface of quills and tail feathers without yellow or red; upper mandible with a distinct lateral ridge and nasal groove. MELANERPES. 96

92. GENUS CAMPEPHILUS GRAY.

159. (392). **Campephilus principalis** (LINN.).**Ivory-billed Woodpecker.**

Adult Male.—Bill, ivory-white. Most of plumage, glossy black; a conspicuous scarlet crest; white feathers covering nostrils; a white stripe beginning under each eye, and extending down the sides of neck, and meeting on the back; secondaries and end of shorter primaries, white. *Adult Female*.—Similar, but with black crest.

Length, 19.75-21.60; wing, 9.00-10.00; tail, 6.25-6.80.

RANGE.—Formerly South Atlantic and Gulf States, from North Carolina to Texas, north in the Mississippi Valley to Missouri, southern Illinois, and southern Indiana. Now restricted to the Gulf States and the lower Mississippi Valley, where only locally distributed (A. O. U. Check List).

Nest, an excavation in a dead tree. *Eggs*, 3-5; glossy white; 1.37 by .99. (Bendire.)

Formerly resident, locally, in the southern part of Indiana; now extinct within our limits. It, like the Carolina Paroquet, has gradually retired from the Ohio Valley, and all the land formerly occupied by it, till now it is only found in certain localities in the Gulf States and the lower Mississippi Valley, being, perhaps, most numerous in Florida. It frequents the heavily wooded lowlands and cypress swamps, excavating its nests in the large dead top limbs of the largest trees. Dr. R. Haymond, in 1869, mentioned it as a former resident of Franklin County, where, he afterwards told me, it frequented the swampy woods and vicinity of the beaver ponds, in what is now Bath and Springfield Townships. From the late Mr. Louis Bollman, Prof. Evermann learned that it was formerly found in Monroe County. Mr. Robert Ridgway recalled having seen it in White County, Ill., which adjoins Posey County, Ind. Audubon mentions it nesting at Henderson, Ky., and speaks of it occurring in Indiana. Undoubtedly, too, Wilson, gained his knowledge from his trip down the Ohio River,

in 1810, to write the beautiful tribute to it, beginning, "Majestic bird! the broad Ohio knows its presence well."

Its white bill has given it the local name of "White-billed Log-cock," or "White-billed Woodcock," to distinguish it from the "Pileated Woodpecker."

There have been reports of its occurrence in this State in recent years, but I have not been able to verify them.

(See Hasbrouck, *The Auk*, Vol. VIII., 1891, pp. 174-186. Also Maurice Thompson, "A Red-headed Family.")

98. GENUS DRYOBATES BOIE.

α^1 . Wing 4.25 or more; outer tail feathers white. *D. villosus* (Linn.). 160

α^2 . Wing under 4.25; outer tail feathers barred with black.

D. pubescens (Linn.). 161

***160. (393). *Dryobates villosus* (LINN.).**

Hairy Woodpecker.

Adult Male.—Above, black, with a long white stripe down middle of the back; sides of head, with white stripes; with a red band across the back of head; the wing coverts and quills with white spots; below, whitish; outside tail feathers, white; others, black, or black and white. *Adult Female*.—Similar, but lacking the red on head. *Immature*.—With the crown more or less red or yellow.

Length, 8.50-9.00; wing, 4.50-5.00; tail, 3.10-3.60.

RANGE.—Eastern United States and South Atlantic and Gulf States; north to Nova Scotia, Quebec and Manitoba; west to Montana, Wyoming, Kansas and eastern Texas. Resident throughout most of its range.

Nest, an excavation in dead or dying tree. *Eggs*, 3-5; glossy white; .93 by .71.

Common resident; more numerous southward in fall, winter and spring. Breeds. Not as numerous as the next species, which is smaller and more sociable, but almost its exact pattern in coloration. Sometimes found about orchards and lawns, and other rather open places, though it frequents the woodland, where it generally nests. It is especially active in its warfare upon insects. Both this Woodpecker and the next have stiff, pointed tongues, sharply barbed for sticking and extracting insects; they are also supplied with a sticky secretion, which assists them in gathering food. They live largely upon the larvæ that bore in the wood or burrow beneath the bark of trees, and upon ants. One instance is recorded of their catching and storing Colorado Potato Beetles. They also eat the fruits of dog-wood, Vir-

ginia creeper, and poison ivy. Prof. Beal informs us that from one-third to three-fourths of its food consists of insects which are chiefly noxious.



Hairy Woodpecker.

(Beal.—Bulletin No. 7, Division of Ornithology and Mammalogy, United States Department of Agriculture, p. 14.)

The examinations made by the United States Department of Agriculture show that 82 of these Woodpeckers ate 68 per cent. of animal matter, 31 per cent. vegetable, and 1 per cent. mineral. Of the animal food, 17 per cent. was ants; 24, beetles, adult and larvæ; 21, caterpillars; 2, bugs and plant lice; 4, spiders and myriapods (Bull. No. 7, Div. O. and M., U. S. Dept. Agr., p. 11).

It mates early, and usually may be found breeding in April, in the dead tops or larger limbs of forest trees. I have noticed it seems to prefer hard maple. One brood is raised in a season. Both birds assist in incubation, which lasts about two weeks. The young are fed by

regurgitation, as are most Woodpeckers. Most people can distinguish it by its larger size. To such it is commonly known as "Big Spotted Woodpecker," or "Big Sapsucker." Against this latter name I desire to protest. It is not a sapsucker, but a destroyer of injurious insects, for which I trust it may receive the protection which it deserves.

***161. (394). *Dryobates pubescens* (LINN.).**

Downy Woodpecker.



Head of Downy Woodpecker. Natural size.

Smaller, but coloration similar to *D. villosus*, except the outer tail feathers, which are barred with black; the smaller size will distinguish it.

Length, 6.25-7.00; wing, 3.55-4.15; tail, 2.30-2.70.

RANGE.—Eastern and northern North America, from Florida to Labrador and North Alaska; west to eastern Texas, Nebraska, North Dakota, Manitoba, Northwest Territory, and irregularly to California and Washington. Resident generally throughout its range.

Nest, a hole in a tree. **Eggs,** 3-6; glossy white; .76 by .59.

Common resident. This is the smallest of our Woodpeckers, and is at the same time the most sociable. It is called "Little Spotted Woodpecker" and "Little Sapsucker." This last it is not. Let no one accuse it wrongly. They come about our homes in winter, even into towns, to let us know that they are present and ever watchful for our interests. When they do not come to us, a walk into the orchard or the wood pasture will almost always bring them within sight. But some windy November day, when rain or snow, one can't tell which, threatens, when every bird is out of sight, a rather deep hollow in the lee of a bluff is found to be peopled by a goodly company, not of Downy Woodpeckers, for they seem never to be very sociable with each other, but a mixed party, a composite of bird life, in which several quite different birds are recognized. The greatest number are Juncos. There are more of them than all other kinds together. A

few Tree Sparrows and a Song Sparrow are with them, chipping on the ground. A pair of Carolina Chickadees and a pair of Tufted Titmice are searching the fence. A few Goldfinches are swinging on the dried Goldenrod stalks, and, last, a pair of Downy Woodpeckers, one of which is vigorously pounding with his bill the trunk of a small willow. All are active; all are happy. Each is talking as earnestly and cheerfully as it can in its own language. Upon the approach of an intruder, all leave, the Downy Woodpecker being the last to go. Tufted Titmice and Juncos lead the way. Such companies are ever found from frost to March. Not always composed of the same kinds of birds, for sometimes one, sometimes another feature will be absent. At other times, Bluebirds, Cardinals, or Nuthatches may be of the company. What a jolly band! Eating weed seeds, destroying insects, and bringing cheer even on the most cheerless days. They roost and pass the most inclement weather in their old nest sites.

Late in March, or early in April, the bands begin to break up. Mating begins sometimes by April 1. Nesting begins about the middle of the month. They nest in holes in fences, in orchard trees, in dead willows along streams, in dead stubs in the woods, generally not high up. Both sexes incubate, which requires about twelve days. But one brood is raised a year.

The food habits of this species are essentially the same as the last. It frequents orchards and yards more. Beginning at the base of a tree, it searches every inch of trunk and branch out to the smallest limb, searching for insects. In summer they may often be seen examining the apples, and from the blossoms occasionally extracting a coddling moth. Its food is much similar to the last, but it eats a larger percentage of insects, principally ants, and less vegetable food. I have often found them feeding upon sunflower seeds, of which they are very fond. The following summary from investigation by the United States Department of Agriculture shows that of 140 stomachs examined, 74 per cent. of the contents was animal; 25, vegetable, and 1, mineral; 23 per cent. was ants; 24, beetles and their larvæ; 16, caterpillars; 3, grasshoppers; 4, bugs and plant lice; 1, flies; 3, spiders and myriapods (Bull. No. 7, Div. of O. and M., p. 11). Prof. Beal notes that of the 7 species examined, our most common one, the Downy Woodpecker, is the most beneficial. Three-fourths of its food is insects, but few of which are useful. The greatest harm it does is in spreading the seeds of poison ivy. These seeds have a hard shell; the juices of the stomach do not destroy them. They are dropped, having full vitality, and sprout where they fall.

91. GENUS SPHYRAPICUS BAIRD.

162. (402). Sphyrapicus varius (LINN.).*Yellow-bellied Sapsucker.**

SYNONYMS, YELLOW-BELLIED WOODPECKER, SAPSUCKER.



Yellow-bellied Sapsucker.

(Beal.—Bulletin No. 7, Division of Ornithology and Mammalogy, United States Department of Agriculture, p. 28.)

Adult Male.—Crown, forehead, chin and throat, crimson; other upper parts, black, marked, or variegated with white or yellowish-white; a line from nostril, below the eye, and one from behind the eye, running backwards, white, sometimes tinged with yellowish; wings, black, the feathers with white spots, generally in pairs; wing coverts, chiefly white; tail with middle pair of feathers and upper coverts mostly

white. Below, belly pale yellow; sides with dusky pointed spots; breast crossed with black, from which a black stripe runs on side of throat to the base of the bill. *Adult Female*.—Chin and throat, white; crimson restricted or wanting on top of head. *Immature*.—Black, red and white of head, neck and breast wanting, or nearly so; above, the mottling more or less brownish.

Length, 7.75-8.75; wing, 4.80-5.00; tail, 2.90-3.20.

RANGE.—Eastern and northern North America, from Costa Rica and West Indies north to Nova Scotia, northern Ontario, Great Slave Lake, Ft. Liard, B. C.; west to Texas, Kansas, North Dakota and Manitoba. Accidental in Greenland. Breeds from mountains of North Carolina, northern New England, Pennsylvania, Ohio, Indiana, Illinois, northward. Winters from Illinois, Indiana and Pennsylvania, southward.

Nest, a hole in a tree. *Eggs*, 5-7; glossy white; .88 by .67.

Winter resident southward, and, occasionally, over most of the State, varying in numbers; rare summer resident northward; common everywhere during migrations.

This is the Sapsucker. Others are called by his name, and get the credit of his deeds. It is more quiet and sluggish than the other Woodpeckers commonly seen. With its bill it pierces the bark of several kinds of trees, making round, oval or approximately quadrangular holes, arranged in circles or spirals, about the trunk or larger limbs. This is done for three things; to secure the sap; to obtain the inner bark (cambium); to attract insects. All of these it feeds upon. It knows when sugar making begins. Then its work upon the sugar and soft maples begins. I have found their borings, from which sap was flowing, February 15, 1896. Through March and into April they continue this work. As warm days come in March, the insects are drawn by the flow of sap and sometimes, upon the east hill-sides, the sound from their wings recalls the hum of a hive of bees. In this way food comes to the eater. But little effort is required on the part of the Sapsucker to supply his wants. In some parts of the New England States it has been observed they have sugar orchards which they frequent regularly. In fall when they come to us they resume their work of piercing the bark of maple, apple, and other trees. Sometimes they merely reopen the old puncture, by cutting the healing edges, and enlarging the hole. I have found their fresh work on young apple trees, never before pierced, as late as November 19, 1895. Pine trees are also girdled, chiefly, however, through the winter, for among them the Sapsucker spends his winter, and about lawns where pines and maples grow together they are most commonly

found at that season. By spring they have removed most of the bark-scales from the pine, and it then appears quite clean. The resin flows from the wounds the bird has made and forms milky streaks and gummy excrescences later in the season, which look unsightly. The damage they do is to lawn and orchard trees. The pines are weakened, their tops girdled until they become bent, and even blown off by the wind. Apple trees and choice maples are seriously damaged, especially when the Sapsuckers are very abundant. I have counted six of these birds, at one time, on a dozen sugar-maples in front of one lot in my own town, and have seen the sap flow in a stream. Mrs. Jane L. Hine, in the spring of 1888, saw one of these birds alight beneath a tap in a small maple tree near its top. It emptied the holes of sap, then waited for it to collect, and drank again. This was repeated time after time for hours. The observer determined to stay until the bird was satisfied or left. She watched it from 10 o'clock in the morning until 5 o'clock in the evening, and then left the bird where she first saw it. In the entire seven hours it had not moved more than a yard from the holes from which it drank. They, of course, get the principal supply of sap at the time when it flows most freely. Then they also eat most of the inner bark. At these times they also eat much insect food, and as summer comes they undoubtedly live more and more upon insects. The tongue is not provided with a spear-like point, and it can not be extended as far as other Woodpeckers project theirs, because of the short hyoid. Instead, the tip of the tongue of the Sapsucker is provided with stiff hairs, and farther back with spines. The hairs may serve as a brush or mop, or to guide the sap onto the tongue, and they and the spines may serve them in their insect-catching. Prof. F. E. L. Beal, in Bulletin No. 7, of the Division of Ornithology and Mammalogy, of the United States Department of Agriculture, informs us that of eighty-one stomachs examined, 50 per cent. of the food was animal and 50 per cent. vegetable. Of the former 36 per cent. was ants; 5, beetles and their larvæ; 2, caterpillars; 1, grasshoppers; 1, bugs and plant lice; 3, flies, and 2, spiders and myriapods. Fruit formed 26 per cent. of the entire food, and the inner bark of trees 23 per cent., most of which was eaten in April and October.

In southern Indiana they usually appear in October, and through that month and well into November they are common. The earliest date I have seen them in fall at Brookville was September 24, 1886. Mr. H. V. Barnett noted the first arrivals in Warren County, September 21, 1897. When with us they utter a call that reminds one of the low mew of a cat. This is most often heard in spring. Gener-



Beal, Bull. No. 7., Div. Ornith. and Mam., U. S. Dep. Agr.

PILEATED WOODPECKER.

ally some winter, some occasionally remain even north of the center of the State. It has been noted at Brookville almost every winter for the past seventeen years. Prof. Evermann reported it from Carroll County December 15, 1884, and January 11, 1885, and Mrs. Hine observed it at Sedan, Dekalb County, January 25, 1894. They begin to become more abundant when sugar-making begins; generally in February and through March are common, some years abundant. Sometimes they leave early in April, April 2, 1893; April 6, 1895. Other years they remain until the last of that month, April 30, 1887. Mr. E. R. Quick saw one in June, 1891. The first migrants arrive at the northern boundary about April 1. Chicago, Ill., April 1, 1885; April 3, 1886; Sedan, March 31, 1896; Laporte, March 30, 1896. I saw them mating at Brookville April 5, 1897, at which date they were common.

It has been found breeding in the following counties: Carroll (Evermann), Laporte (Coburn); Starke, English Lake, "abundant breeding," June 3, 1888 (Deane); Dekalb, 1888, 1890 (Mrs. Hine), 1889 (H. W. McBride); Porter, 1895, 1896 (Parker). Mrs. Hine first observed the Sapsucker in summer in 1888. That summer she saw their young oftener than those of any other woodpecker. In the summer of 1890 she saw old birds feeding their young. Mr. H. W. McBride took three eggs from a nest, near Waterloo, May 13, 1889. Mr. J. G. Parker, Jr., collected one young, saw them at Kouts in 1895. He found it breeding at the same place May 28, 1896. The nests do not differ from those of other woodpeckers. They have been found from eight to fifty feet high. Eggs may be looked for in May. An egg is laid daily until the set is complete. Both parents take part in incubation. The young are fed almost wholly upon insects. At that time the old birds develop an expertness at fly-catching that is very noticeable. Aside from their damage to orchards and lawn trees, they are very beneficial birds.

95. GENUS *CEOPHLEUS* CABANIS.

*163. (405). *Ceophloeus pileatus* (LINN.).

Pileated Woodpecker.

SYNONYMS, BLACK WOODCOCK, LOGCOCK, BIG BLACK WOODPECKER.

Adult Male.—Brownish-black; top of head, conspicuous crest and stripe from base of lower mandible, bright red; white stripe from the eye, and one from the nostril, backwards and along the side of the neck, white and yellowish; throat, white; bases of wing feathers, white;

bill, dark. *Adult Female*.—Similar, but with fore part of head blackish, and red stripe at base of lower mandible wanting. .

Length, 15.15-19.00; wing, 8.90-10.00; tail, 6.60-7.40.

RANGE.—Formerly the heavily-wooded region of North America, south of about latitude 63 degrees, and Mexico, except in the southern Rocky Mountains; now rare or extirpated in the more thickly settled parts of the Eastern States.

Nest, excavation in tree. *Eggs*, 3-5; glossy white; 1.28 by .95.

Resident, confined to the more heavily-timbered and more inaccessible portions of the State. Rarely breeds. It was formerly very common, but disappears before civilization. To the older settlers it was known as "Logcock," and "Black Woodcock." It is about thirty years since I can hear of its occurrence in Franklin County. In 1890 I reported it from several counties in which it had been noted, or taken mostly within five years preceding (Proc. Ind. Hort. Soc., 1890, p. 59). From the following, I have no more recent record: Vigo, Dekalb, Decatur, Allen, and Gibson. Since that time it is reported from the following counties: Boone and Fountain; specimens in collection of the State Museum; Knox, rare, 1894, February 4, May 24, October 19, one; spring of 1897, two. I saw one fly through the main street of Carlisle, Ind., August 14, 1897 (Chansler). Brown, 1894, rare (Kindle), May 24, one (Barnett); 1895, April 6, two; April 15, April 16, very few (Miss Jacobs). Monroe, 1892, February 13, saw two, took female (Ulrey); Porter, 1894, December 5, saw a male killed by George Wilcox, at Kouts; 1896, December 11, I saw three near same town (J. G. Parker, Jr.).

Mr. C. E. Aiken also informed me he obtained a specimen at Water Valley, Lake County, where it was rare, a few years ago. I have no doubt of its occurrence in limited numbers still in Gibson and, perhaps, several other counties in southwestern Indiana. In fact, it may exist wherever there are extensive woods that are not much frequented. They are more liable to be seen in winter, as the leafless woods and their tendency to range to some extent for food then makes them more conspicuous. Mr. H. Nehrling gives an account of these birds, which every one who has known them in our State will recognize as his own experience. He says: "The Pileated Woodpeckers were constantly at work; with powerful strokes they hammered off the bark and captured their insect prey. Their beauty, activity and docility excited my admiration. When I approached one of them too closely, it uttered a loud and laughing *ha-he, ha-he*, and then took wing. It is very noisy during mating season, and indulges a good deal of its time in drumming on a dry, hollow limb. Its call-note sounds like, *a-wick*,

a-wick, but, it also utters a *tack-tack-tack*, which is several times repeated (N. A. Birds, Pl. xvi., p. 411). Eggs may be looked for with us late in April and through May. Its nests are excavated in dead trees or snags from 12 to 75 feet up. The opening is 3 to 3½ inches in diameter, and the excavation is from 7 to 30 inches deep, being larger at the bottom, which is covered with chips, or, sometimes, sand. A new one is generally built each year. They also use a nest or excavate a shelter for protection in severe weather. An egg is laid daily. The period of incubation is about 18 days. In this, as in digging the nest and caring for the young, both birds share. But one brood is raised each year.

This is the largest Woodpecker in the United States except the Ivory-bill. Its powerful bill enables it to tear off tough bark, and dig deep into trees for grubs, borers and ants. Such is its work. Prof. Beal examined 23 stomachs, all taken in fall and winter; 51 per cent. of the contents was animal, and 49 per cent. vegetable matter. The animal matter was chiefly insects, of which ants, beetles, and wood-boring larvæ formed the greater part (Bulletin No. 7, Div. O. and M., U. S. Dept. Agr., p. 32).

96. GENUS MELANERPES SWAINSON.

*a*¹. Head and neck deep red or grayish brown; back black.

***M. erythrocephalus* (LINN.). 164**

*a*². Head grayish, more or less red on crown; back and wings banded transversely with black and white.

***M. carolinus* (LINN.). 165**

Subgenus MELANERPES.

*164. (406). ***Melanerpes erythrocephalus* (LINN.).**

Red-headed Woodpecker.

Synonym, RED-HEAD.

Adult.—Head, neck and breast, crimson; rump, end of secondaries and remaining under parts, white; back, glossy blue-black; bases of secondaries, primaries and tail, black. *Immature*.—Crimson parts replaced by grayish-brown.

Length, 9.25-9.75; wing, 5.30-5.70; tail, 3.60-3.75.

RANGE.—Eastern United States, west to Rocky Mountains; from Florida to northern New York, Ontario, Nova Scotia, Manitoba. Rare east of Hudson River. Accidental in Utah and Arizona. Winters irregularly throughout northern New York, Pennsylvania, Indiana, Michigan. Breeds throughout its range.

Nest, a hole in a tree. *Eggs*, 4-7, rarely 8; glossy white; .99 by .76.

It is not necessary to introduce the familiar "Red-head" to any Indian. It is liable to be found resident in any part of the State, but not always frequenting the same localities winter and summer. However, it usually migrates from the northern part when cold weather



Red-headed Woodpecker.

(Beal.—Bulletin No. 7, Division of Ornithology and Mammalogy, United States Department of Agriculture.)

comes, and occasionally seems to leave the State almost entirely. The severity of the weather does not govern their removal. Food supply is the great factor. Some mild winters they leave. Other severe winters they stay. The abundance of mast keeps them. Beechnuts are the favorite winter food, but all kinds of acorns and other nuts are eaten. Wherever there are quantities of beechnuts, there these Woodpeckers winter. Some winters they are found in one locality and are absent in others. They disappear every winter from the Whitewater Valley, and other localities where beechnuts are not

found. The past year they were not seen along the Whitewater River from October 1, 1896, to April 20, 1897; while in the beechland of Decatur and Shelby counties, they were found all winter. Into the river lowlands it comes as a migrant, while it is resident in the beech woods ten to twenty-five miles away. The winter of 1895-6, it remained in Wayne and Jefferson counties, and at the north end of the State in Dekalb County, where it was found common in colonies (Mrs. Hine). The winter of 1894-5, they wintered in the following counties, in most of them commonly: Brown, Decatur, Putnam, Boone, Parke, Tippecanoe. In 1893-4, in Decatur and Dekalb, but none remained in Brown, where there were no beech-nuts, and where they were the next winter. In 1892-3, they wintered in Lake County, but none remained in Monroe. In 1891-2, they remained in Monroe, Rush, and Dekalb.

The winters of 1888-9 and 1885-6, they wintered in the vicinity of Chicago; 1887-8, in Vigo County, in large numbers; beechnuts were common; 1886-7, at Grand Rapids, Mich., and Marion County, Ind. When they all disappear, they are liable to return at any time between March 1 and May 1. Usually, however, they appear in April. This Woodpecker has learned to store its winter food. While it does not do so to the extent the California Woodpecker does, yet at times this habit is quite noticeable. Dr. Haymond was first to observe it here (Proc. P. A., November, 1856, p. 293). Mrs. Hine tells me the winter of 1891-2, they stored, in addition to beechnuts and acorns, some hickory nuts. Prof. O. P. Hay has given the result of his observations of the hoarding habits of this bird near Irvington in the winter of 1886-7, in "The Auk," Vol. IV., July, 1887, pp. 193-196.

The Red-headed Woodpecker is not as common as it formerly was. When deadenings were numerous, the numbers of these Woodpeckers therein is beyond estimate. To know these birds as they were, one should live where a deadening of beech timber was near a cherry orchard. There, through June, times were lively and the gay, tri-colored bird of which I wrote was one of the chief factors.

The more attractive mating-call, *Kurr-kurr*, of a month before has given place to the harsher *Kahrr-kahrr*, which sounds from woods, fence stakes and cherry trees from sunrise till dark. They mate from the first to the middle of May. The nest is in a dead snag or the dead top of a live tree. Beech, maple, and sycamore, are most used here, from 10 to 80 feet high. In prairie districts, fence posts and telegraph poles are used. One egg is laid a day; incubation sometimes begins before the set is laid, and lasts about two weeks. Both parents take part in preparing the nest, incubating and caring for the young. But one brood is reared a year.

In August they often begin to disappear from their accustomed places. Mr. V. H. Barnett informs me that on the night of October 30, 1897, at 8:15 p. m., he heard the Red-headed Woodpecker and some warblers flying south.

The Red-headed Woodpecker has the greatest range of food of our species. At times its chief food is fruit; for another period it may be chiefly insects; again, it will live on nuts and cereals. Of 101 stomachs reported upon by the United States Department of Agriculture, 50 per cent. contained animal matter; 47 per cent. vegetable matter; 3 per cent. mineral matter. The animal matter was insects, of which there were found ants, wasps, beetles, bugs, grasshoppers, moths, caterpillars, spiders, and myriapods. Ants amounted to about 11 per cent.; beetles, nearly one-third, and grasshoppers and crickets, 6 per cent. Seventeen, collected from May to September, had eaten corn, one had eaten strawberries; 15, blackberries, raspberries; 2, cultivated cherries; 4, apples; 6, pears (Beal, Bulletin No. 7, Div. O. and M., pp. 24, 25). Prof. Forbes found that of these birds he examined, 32 per cent. of their food was canker worms (Rep. Mich. Hort. Soc., 1881, p. 204). This Woodpecker seems to be able to adapt itself to any circumstances. It has been accused of robbing birds of their eggs, and I have seen it catching insects after the manner of a flycatcher. While it eats some fruit, except berries and cherries, it eats too small an amount to amount to much. On the contrary, its insect-eating, in which it destroys many large beetles and quantities of grasshoppers, makes it a very beneficial bird ordinarily.

Besides, from the variety of its foods, it is a valuable factor in a contest with any unusual increase of old or the sudden appearance of new insect foes.

Subgenus *CENTURUS* Swainson.

***165. (409). *Melanerpes carolinus* (LINN.).**

Red-bellied Woodpecker.

Synonyms, GUINEA WOODPECKER, ZEBRA WOODPECKER, CAROLINA WOODPECKER, CHECKERED WOODPECKER.

Adult Male.—Above, crown and nape, scarlet; back and wings, except larger quills, regularly barred with black and white; primaries and secondaries, chiefly black, the former mostly white at base, the latter spotted with white; rump, chiefly white; sides of head and under parts, grayish-white, sometimes with yellowish tinge; belly, washed with reddish; outer tail feathers, black and white barred;

inner web of central feathers, white with black spots; their outer webs black with more or less white next the shaft. *Adult Female and Immature*.—Crown, grayish; nape and nostrils only, scarlet.

Length, 9.00-10.00; wing, 4.85-5.50; tail, 3.50-3.95.

RANGE.—Eastern United States, from Florida and Texas north to Massachusetts, New York, Pennsylvania, southern Ontario, southern Michigan, southern Wisconsin, South Dakota. Breeds north to Pennsylvania, and thence westward throughout its range. Winters almost throughout its range.

Nest, an excavation in a tree. *Eggs*, 3-5; white; .99 by .73.

Resident, rare northward, more numerous southward, common in southern third of the State. While they do not migrate as a body, they are less common north and more common south in winter. It prefers the heavy timber. Along the Whitewater and Ohio rivers it is seldom seen in the lowlands, but upon the top of the bluffs and farther back upon the uplands wherever white oak trees are found it is common. Its call is something like *Kurr-urr-urr*, more or less lengthened, while a note when disturbed or when hammering is *Chow-chow*. They are shy and suspicious, and as one tract of woods after another is cleared away, the birds that peopled each disappear. It has been reported as resident in the following counties in Indiana: Lake, rare (Meyer); Porter, not uncommon at Kouts (Parker); Laporte (Barber, Byrkit); Dekalb, rather common (Mrs. Hine); Michigan, Kent County, not very common (Moseley); Wayne, a few winter (Trombley). They begin mating in March; one was seen excavating for a nest March 24, 1892 (Mrs. Hine). Eggs may be taken any time from April 15 to June 1. Nests are usually made in dead tops of living trees from 15 to 60 feet high. Eggs are laid daily. Incubation lasts about fourteen days. Both sexes share in nest-making, sitting and caring for the young. Generally only one brood is raised (Bendire, L. H. N. A. Birds, pp. 123-124). The Red-bellied Woodpecker is the vegetarian of its family. Of 22 stomachs examined, 26 per cent. of the contents was animal and 74 per cent. vegetable food; 14 had eaten ants amounting to 11 per cent.; 10 per cent. of the total food was beetles. The vegetable food was entirely wild fruits and seeds. Only 2 had eaten corn. August 10, 1897, I found one eating Benoni apples, and it was with difficulty it could be driven away. I was told they had eaten most of the apples, which were small and knotty. In winter they live upon wild fruits and seeds, but years when mast is plenty they doubtless live principally upon acorns and beechnuts. Their evil deeds are few and the good they do very much. Dr. Haymond notes this bird has, like the Red-headed Woodpecker, the habit of hoarding nuts.

97. GENUS COLAPTES SWAINSON.

166. (412). Colaptes auratus (LINN.).*Flicker.**

Synonyms, GOLDEN-WINGED WOODPECKER, HIGH HOLE, HIGH HOLDER, WICKUP.



Flicker.

(Beal.—Bulletin No. 7, Division of Ornithology and Mammalogy, United States Department of Agriculture, p. 17.)

Adult Male.—Back, wing-coverts and inner quills, brownish, barred with black; rump and upper tail-coverts, white; outer edge of quills and tail feathers above, black; shafts of feathers and under surface of same, golden-yellow, the tail feathers tipped with black; head and nape, grayish, the latter with scarlet band; a black stripe on each side of throat; below, chin, throat and breast vinaceous, the last bordered by a large black crescent; rest of under parts paler vinaceous, with black spots. *Adult Female*.—Similar, but without the black streak on each side of throat.

Length, 12.00-12.75; wings, 5.50-6.60; tail, 4.00-4.95.

RANGE.—North and eastern North America, from eastern Texas and Florida north to Labrador, Hudson Bay, Alaska and the Arctic Coast. West to Nebraska, North Dakota, Assiniboia. Accidental in

Greenland. Breeds throughout its range. Winters from Pennsylvania and Indiana, irregularly from New Brunswick, Maine and Michigan, southward.

Nest, a hole in a tree. *Eggs*, usually 5-9; glossy white; 1.10 by .85.

Resident, very common southward. Rare in the north part of the State; common everywhere throughout the warmer parts of the year. Breeds.

The nearer the Ohio River in winter, the more numerous this bird becomes. It is, however, tolerably common from the Wabash River south. In both Tippecanoe and Carroll counties it is a common resident. In the following northern counties it is found, at least some years, throughout the winters: Porter, rare (Parker); Dekalb, rare (H. W. McBride, Snyder); a few also winter in Wayne County, Mich. (Trombley). The migratory birds return to their homes in February and March, and during the latter month and October and late November, they are very abundant, frequenting pastures, meadows and stubble.

This species is decidedly terrestrial, spending much time upon the ground. During the colder months, they are semi-gregarious. With us, they sometimes begin mating by March 7 (1882), other years, not until March 30 (1893). Eggs may be found, perhaps, late in April, but the earliest date full sets are recorded is May 4. Through May and June they may be found. Like other woodpeckers, it nests in the woods, but it also loves to make its home in an old apple limb, or dead snag in the lawn. It uses either a natural or artificial cavity. Although found so much upon the ground, its high nesting has given it the name of "High-hole." Usually, but one brood is raised in a season, but if the eggs are removed as laid, the fecundity of this bird is remarkable. Between May 4 and June 22, 1885, Prof. B. W. Evermann, in Carroll County, took 37 eggs from a single nest. Between those dates they rested 14 days. There is one instance recorded where by leaving a nest-egg, a Flicker laid 71 eggs in 73 days. An egg is laid each day. Usually incubation does not begin until the full set is laid, but sometimes it does. It has the greatest number of calls of any member of its family. Its *Wake-up, wake-up*, have, in some localities, given it a local name. Its *Quit-tu, quit-tu*, recalls the stroke of a master hand with a scythe-stone upon a scythe. *Chuck-up, chuck-up*, is another well-known sound. These, with a dozen more vocal expressions to represent every phase of courtship or variation of bird-feeling, are known to all who live where the Flicker does.

The Flicker, with its curved bill, can not chisel its way into trees as the other species do. It, therefore, does not destroy so many insects

injurious to trees. In fact, except ants, of which it eats great numbers, it is not so destructive to insects as the other Woodpeckers are.

The stomachs of 230 Flickers examined showed animal food 56 per cent.; vegetable food, 39 per cent.; mineral food, 5 per cent. Of the animal matter, which was insects, the percentage was divided as follows: Ants, 43 per cent.; beetles, and their larvæ, 10; caterpillars, 1; grasshoppers, 1; spiders and myriapods, 1 (Beal, Bulletin No. 7, Div. O. and M., U. S. Dept. Agr., p. 11). Several stomachs contained nothing but ants. In two, the actual number of ants in each stomach exceeded 3,000 (Ibid, p. 17). The vegetable material it eats is principally that which grows wild.

N. ORDER MACROCHIRES. GOATSUCKERS, SWIFTS, ETC.

SUBORDER CAPRIMULGI. GOATSUCKERS, ETC.

XXXIII. FAMILY CAPRIMULGIDÆ, GOATSUCKERS, ETC.

α¹. Gape with long bristles; tail even or rounded; plumage fluffy.

ANTROSTOMUS. 98

α². Gape without long bristles; tail forked; plumage more compact.

CHORDEILES. 99

98. GENUS ANTROSTOMUS GOULD.

α¹. Wing over 8.00; rictal bristles with lateral branches.

A. carolinensis (Gmel.). 167

α². Wing under 7.00; rictal bristles not branched. **A. vociferus** (Wils.). 168

*167. (416). **Antrostomus carolinensis** (Gmel.).

Chuck-Will's-Widow.

Adult Male.—Bristles at the base of bill, branched. Above, mottled with gray ochraceous, tawny and black, and more or less streaked with black; primaries, dusky spotted, with ochraceous. Below, tawny or buffy and grayish, mottled with dusky; throat and crissum, more ochraceous; inner web of three outer tail-feathers, white or ochraceous. *Adult Female*.—Similar, but inner web of three outer tail-feathers without white.

Length, 11.00-12.00; wing, 8.70-8.90; tail, 6.26-6.30.

RANGE.—America, from Colombia and West Indies north to southern Virginia, West Virginia, southern Indiana, Southern Illinois and

south Missouri; west to Texas and Indian Territory, casually to southern Kansas; accidental in Massachusetts. Breeds throughout most of its United States range. Winters from Florida and Louisiana southward.

Eggs, 2; laid on ground; white, cream, or pinkish, blotched or veined with different shades of brown, purplish and gray; 1.41 by 1.01.

Summer resident in lower Wabash Valley, at least as far north as Knox County. Breeds. In that region it is not uncommon. In 1865, Mr. Ridgway heard it as far north as Richland County, Illinois, three miles south of Olney. He says its habits are essentially the same as those of the Whip-poor-will, and its notes are somewhat similar, but louder and easily distinguished after once being heard (Ridg., *Birds of Ill.*, I., p. 367). Mr. Ridgway wrote me of its occurrence in this State, as follows: "I have both seen the Chuck-will's-widow, and frequently heard its unmistakable note in Knox County, Ind., immediately opposite Mt. Carmel" (Ill.) Mr. William Brewster and Mr. Ridgway identified this species on the Indiana side of the Wabash, April 20, 1878.

- *168. (417). ***Antrostomus vociferus*** (WILS.).

Whip-poor-will.

Adult Male.—Bristles at the base of bill, not branched. Above, mottled, gray, brown and tawny, more or less streaked with black, which is not conspicuous on the grayish crown and wing coverts; primaries, blackish, spotted and barred with ochraceous rufous; the three outer pairs of tail feathers with the terminal half white. Below, mottled as above; darker forward, lighter behind; a white band across the neck. *Adult Female*.—Similar, but the three outer pairs of tail-feathers tipped with reddish or buffy white; band across the neck more brownish.

Length, 9.10-10.00; wing, 5.80-6.70; tail, 4.80-6.50.

RANGE.—North America, from Guatemala and West Indies north to Nova Scotia, southwest Keewatin and Manitoba; west to North Dakota, western Kansas and Texas. Breeds from Florida and Louisiana northward. Winters from Florida, Louisiana and, rarely, southern South Carolina.

Eggs, 2; deposited on ground; white, or creamy-white, spotted and streaked with different shades of brown, lilac or pearl-gray; 1.15 by .84.

Common summer resident; breeds. Prefers more open woods overgrown with underbrush, or bushy pastures.

The members of this family afford an excellent opportunity for migration notes. They are generally known, and any careful person can make the observations. Their movements are greatly regulated by weather.

There is a favorite region two miles south of my home where Whip-poor-wills and Brown Thrashers may be found from two days to two weeks earlier than they reach me. For several years dates have been kept that establish this. Mr. O. M. Meyncke reports hearing the unmistakable voice of the Whip-poor-will in Highland Township March 2, 1897. The unprecedented warm weather of the previous few days, resulting in unusual storms, may have induced its exceedingly early appearance (The Osprey, Vol. I., May, 1897, p. 123).



Whip-poor-will.

Excepting that the earliest record is from New Albany, where it was taken April 2, 1893, common April 5; at the following points it was first noted the same year; when a second date is given it indicates the date it became common: Moore's Hill, May 7; Bloomington, April 29; Kilmore, April 27, May 1; Lafayette, April 29; Camden, May 2; Petersburg, Mich., April 15, April 20.

In 1892, New Albany, April 6, April 12; Brookville, April 6; Bloomington, May 7; Rochester, April 23, April 30; Medora, April 23, May 1; Petersburg, Mich., April 28, May 1. In 1885, it was first noted at Brookville April 18; Chicago, Ill., April 21. In 1886, Brookville, April 14; Bloomington, April 21; Petersburg, Mich., April 14; Chicago, Ill., May 6.

In sixteen years, the earliest date of first arrival at Brookville was in 1893, as given, and the latest, April 26, 1881. In the southern half of the State it is generally common between April 5 and 20; in the northern half, between April 17 and May 5. They mate soon after arriving. I noted them mating April 25, 1887. Eggs are usually found from May 1-10, at Brookville. The two eggs are usually laid on a leaf or a few leaves in a slight depression. Upon our wooded hill-sides they may be found upon the natural terraces, and frequently

when the bird suddenly leaves the nest it will scatter them; sometimes they roll down hill. The color of the Whip-poor-will so harmonizes with the leaves that even when one knows where to look he can with difficulty make out the form of the bird.

On sunny days it sits with eyes apparently shut. Then it will permit a hand within about a foot of itself and quickly and quietly leaves its nest. I have never known a sound to escape one when leaving the nest. At other times, when one is flushed, it utters a *cut*, similar to that of a turkey, which is often repeated two or three times. The female attends to incubation, which begins when the first egg is laid. If the nest is disturbed, the old bird will frequently remove the eggs and the young, it is said, in its mouth, to a more retired spot.

At dark they come from the woods and thickets and engage in a warfare with insects. They even come into town. I have often known one to alight upon my doorstep, pavement or gravel walk near my house, and repeat its call, sometimes five or six times in succession, every little while, until disturbed. Undoubtedly, they were there after insects, attracted by the light.

The food of two examined by Prof. F. H. King was, 10 moths, 14 beetles, some of which were click-beetles and smaller lamellicorns, and 162 insect eggs (Geol. of Wis., Vol. I., p. 564).

Prof. A. L. Herrera notes the assistance they render in destroying many of the gnats (*Culex*) that sometimes infest the Valley of Mexico (*Ia Naturaliza*, 2d series, Vol. I., 1888, No. 4, p. 170).

The song of the Whip-poor-will continues well into June, perhaps sometimes into July. It rarely sings in the fall. I heard it September 14, 1887, and a friend reported two singing before daylight on the morning of September 4, 1897. That is also the latest I have ever noted it. They are certainly fewer in July, and still more so in August. Generally all are gone by August 27 to September 7, but Mr. L. F. Meyer reports it remaining in Lake County until October. In 1897 they were last seen in Warren County, September 13 (V. H. Barnett).

99. GENUS CHORDEILES. SWAINSON.

*169. (420). **Chordeiles virginianus** (GMEL.).

Night Hawk.

Synonym, BULL BAT.

Adult Male.—Above, black, more or less mottled, with grayish-brown and tawny; primaries, brown, the five outer ones marked about midway with a white spot. Below, a white V-shaped mark on the

throat; other under parts with transverse bars of white, blackish and pale-tawny; tail, blackish, with marbled cross bars and a white band across the end. *Adult Female*.—Tail without the white band across the end; the white of the throat replaced by tawny.

Length, 10.00; wing, 7.30-8.25; tail, 4.30-4.75.

RANGE.—America, from Brazil north to Nova Scotia, Hudson Bay, Keewatin and Mackenzie River (Ft. Good Hope); west to Great Plains and casually to Pacific Coast from California to British Columbia. Breeds from coast of Gulf States northward. Winters south of the United States.



Night Hawk.

Eggs, 2; laid on the ground or on flat roof of building; white, cream, olive-buff or olive-gray, marked with black, gray and lavender; 1.18 by .86.

Abundant migrant, most numerous in fall; in northwestern Indiana a common summer resident, locally elsewhere in some numbers. Breeds in suitable localities. In Knox and Hamilton counties a few remain during the breeding season. In Lake County it breeds commonly. In the following other counties it has been reported to breed: Clinton, Pulaski.

They arrive later in spring than the "Whip-poor-will," and by most persons are unobserved. The earliest spring arrival for the State is at Bicknell, April 24, 1897, next seen April 30.

The following records will show its progress, that spring. The second date indicates when it became common, if reported: Carmel, May 22; Edwards, May 2, May 15; Richmond, May 20; North Man-

chester, May 22, May 27; Waterloo, May 19, May 24; Sandusky, O., May 15; Chicago, Ill., May 22, May 28. In 1896, the first reached Laporte April 28, common May 10. The earliest and latest date of first arrival in 16 years at Brookville is, respectively, April 26, 1886, and May 17, 1885. The corresponding records at Petersburg, Mich., for 9 years are May 1, 1886, and May 21, 1891. Sometimes I have seen them gracefully winging their way north during the brightest May days, high in the air and uttering their call, which reminds me of the "scape" call of Wilson's snipe. It may be interpreted "*Skeep*." In fact, it is not a night bird, but rather one that is active cloudy afternoons and in the twilight, and rests when night falls. It is not a bird of the woods, but prefers to nest in open ground. Its graceful flight, interesting evolutions and strange noise at mating time interest all bird lovers. Ascending high in air, the male, with stiffened wings and tail, descends almost as rapidly as a flash of light; the noise produced by the air against the wings is a peculiar booming sound which has been compared to that made by blowing into the bunghole of an empty barrel. It would seem the bird would dash itself to pieces on the ground, but suddenly the wings change position and gracefully it curves outward and upward, then circles again into the higher air. They nest in fields, upon the ground. Two eggs are laid on alternate days. Incubation begins when the first one is laid. In Cincinnati, Detroit and Chicago it has been found to breed upon the flat roofs of buildings. It does not breed in the Whitewater Valley so far as reported. Its eggs are to be found in northern Indiana from May 27 to last of June, and sometimes into July.

Prof. F. H. King, from dissection, found that five had eaten 19 beetles, 23 heteroptera, 9 grasshoppers and 4 neuroptera. The material taken from the stomach of one specimen weighed 9 grammes (Geol. of Wis., I., p. 564). They are very destructive to flying insects.

In August and September they pass south in great numbers. About four o'clock in the afternoon they begin to appear along our streams, and by sundown a continuous stream may be seen passing down the river. In 1896 they were first noted August 21. That is the earliest record I have from Brookville, though Mr. V. H. Barnett saw them in Brown County August 12, 1895. The last fall record I have from Chicago is September 28, 1895; from northern Indiana, Lafayette, September 25, 1895; southern Indiana, Bicknell, October 4, 1895; usually all have left before October 1. Marksmen use these birds as targets for practice. Undoubtedly many are thus killed.

SUBORDER CYPSELI. SWIFTS.

XXXIV. FAMILY MICROPODIDÆ. SWIFTS.

SUBFAMILY CHÆTURINÆ. SPINE-TAILED SWIFTS.

a'. Tail rounded or even; feathers with spiny points at end. CHÆTURA 100

100. GENUS CHÆTURA STEPHENS.

*170. (423). *Chætura pelagica* (LINN.).

Chimney Swift.

Synonym, CHIMNEY SWALLOW.



Head and tail feather of Chimney Swift. Natural size.

Above, sooty-brown, with faint greenish gloss; wings, black. Below, paler; chin and throat, grayish.

Length, 5.25-5.40; wing, 5.00-5.25; tail, 1.90-2.15.

RANGE.—Eastern North America, from southern Mexico north to Labrador and Manitoba; west to Texas and Nebraska. Breeds from Florida and Texas northward. Winters south of United States.

Nest, half-saucer shape, of twigs glued together and attached to side of chimney or hollow tree. *Eggs*, 4-6; white; .79 by .52.

Abundant summer resident. Breeds. In the early history of this State these birds nested in hollow trees, and there are localities where a few do so yet. Only a few years ago a large hollow sycamore near Brookville, that for years was occupied by them, was cut down. The large, old-fashioned chimneys were used by them in great numbers, and they became such a nuisance that wire cloth was fastened over them to exclude them. They do not use the smaller chimneys so commonly. I have known them to nest in stables and other deserted buildings. Through the latter part of April they are seen mating, but it is well into May before they begin breeding. The nests are composed of dead twigs fastened to each other and to the wall with a

gummy secretion from the mouth. The twigs are broken as the birds fly, being grasped by the feet and wrenched off. In my yard, I have noticed they usually take dead apple twigs. Mr. Widmann says it takes two months to rear a family of Swifts.

When the young are able to leave the nests, they remain in the chimney, clinging to the sides for some time. For several weeks a chimney, connecting with a bed-chamber, containing a few nests of these birds, is a source of the most uncanny sounds and annoying hissings, which render rest by day impossible, and occasionally unaccountable noises at night awaken the soundest sleeper. Often the entire younger portion of the family will tumble down the flue; if there is an open fireplace they enter the room, where they produce much dirt and disorder, if left a few hours. One of my earliest recollections, going back to the time of pinafores, is of 15 or 16 of these young birds, almost able to fly, hanging to my apron front, their cries and mine joining in vociferous rivalry.

The earliest record for Brookville is April 5, in each of the two years 1888 and 1897. The latest first arrival there is April 22, 1895. The earliest record for the State is April 4, 1889, New Harmony, where it became common April 13. It spread all over the State early that year, reaching Petersburg, Mich., April 20, becoming common May 1. In 1888 it arrived unusually early. It was first observed all over the southern part of the State, as far north as Terre Haute and Brookville by April 7, and became common at once, but its course was stayed, and it did not reach Petersburg, Mich., until May 2, and became common May 10. The following dates for 1897 show it was very early in southeastern Indiana, while the Wabash Valley, excepting Lafayette, was behind: Brookville, April 5; Richmond, April 12, April 15; Anderson, April 16, April 30; Muncie, April 17; Bicknell, April 17, April 21; Spearsville, April 19; Lafayette, North Manchester, April 22, May 5. The first bird was seen at Chicago, Ill., and Sandusky, O., the same day, April 24. Common at Chicago, May 1; at Sandusky, April 25. It did not reach Petersburg, Mich., till May 4, and was common May 10. At Chicago it has been noted as first arrival April 24 to May 5; at Petersburg, Mich., from April 20 (1889) to May 4 (1897).

In fall, usually they disappear in September. Most of them leave the northern part of the State early in that month. Some, however, sometimes remain well into October. Their last fall dates at Lafayette are: 1894, October 12; 1895, September 30; 1896, September 29. At Sandusky, O., it has been reported to Prof. Moseley, October 15, 1896. In 1886 it remained in Brookville until October 7, and in 1897 they

were common October 13, which is the latest I have seen it. They stay until a sudden cold snap comes, and then leave. October 5, 1894, they were common—one of our chimneys was alive with them. Next day it grew colder all day, and at night it was necessary to build a fire in that fire-place, but the swifts were all gone.

Their food is entirely insects, largely flies and other small forms, which they take in the air.

SUBORDER TROCHILI. HUMMING BIRDS.

XXXV. FAMILY TROCHILIDÆ. HUMMING BIRDS.

a¹. Back golden green; bill straight; first primary not excessively lengthened.

TROCHILUS. 101

101. GENUS TROCHILUS LINNEUS.

Subgenus TROCHILUS.

*171. (428). *Trochilus colubris* LINN.

Ruby-throated Humming Bird.

Adult Male.—Tail, deeply forked; above, metallic green; wings and tail, dusky purple; below, white, a ruby-red gorget; sides, greenish.

Adult Female.—Tail, not deeply forked, the feathers barred with black, outer ones tipped with white; lacking the metallic gorget.

Young.—Similar to female, but with tail more like the male.

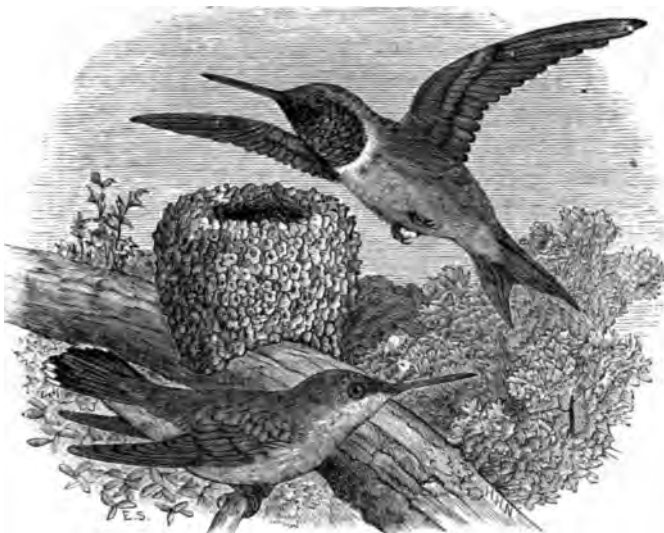
Length, 3.07-3.25; wing, 1.60; tail, 1.25.

RANGE.—Eastern North America, from Central America and West Indies to Labrador and Northwest Territory; west to Great Plains. Breeds throughout its range. Winters from Florida southward.

Nest, of lichens and vegetable fibre, covered with lichens and saddled to a horizontal limb. *Eggs*, 2; white; .51 by .33.

Common summer resident. Breeds. There are many beautiful and interesting birds found throughout our State, but beside this little flying gem all others are as common pebbles beside the ruby. We all continue to share the feeling of childhood, and gaze in inquiring wonder as we see it come from somewhere and gather food, as its humming wings carry it from flower to flower among the nasturtiums, and disappear over the fence as suddenly as it came. This is the only kind of humming bird found in the eastern United States. Its average time of arrival in southern Indiana is May 1; in the northern part of the State, May 10. I have taken it at Brookville as early as April 20, 1896; and it delayed arriving until May 9 in both 1888 and 1889.

Although they come tolerably late, they are sometimes destroyed by late cold weather. May 20, 1883, many must have perished from cold. Several dead were brought to me, and others reported. May 19, 1895, Messrs. Ulrey and Wallace reported dead found in Wabash County after cold weather (Proc. I. A. S., 1895, p. 152). At Sedan the earliest and latest record of first arrival is April 29, 1891, May 19, 1889; at Petersburg, Mich., April 28, 1896, May 22, 1890. The fol-



Ruby-throated Humming Bird—Male, female and nest, slightly reduced.

lowing record of first arrival, and date it became common, when given in 1897, are presented: Bicknell, April 29, May 12; Edwards, May 4, May 15; Hanover, May 6, May 10; Brookville, May 8, May 9; Richmond, May 4, May 17; Anderson, May 12; North Manchester, May 15, May 25; Lafayette, May 16; Waterloo, April 29, May 20. Only one was seen on first date at Waterloo, and no other until May 16.

Humming Birds frequent certain localities. Some places they may always be found; others, rarely. In late summer they gather in great numbers about certain flowers. One sand bar I know, near Brookville, covered with Bouncing Betty, is a favorite place. They gather there by hundreds in August and early September. At a certain locality near Lafayette, where wild Touch-me-nots flower profusely, forty or fifty Humming Birds may be found most any evening, or morning, at the same season. Petunias, Gladioli, and Cannas, are visited, too, while earlier in the season the favorite flower is the Trumpet Creeper (*Tecoma radicans*). The food of this little bird is minute insects,

nectar from flowers, and the sap of trees. Their nests are usually built of fine fibre and lichens, on a horizontal limb, in some retired spot along the borders of the wood. I know of one over the bars into a wooded pasture, where many people and cattle pass each day. They look like lichen-covered knots. They pair at once upon arrival. May 12, 1882, I found a complete nest, and the next day found one with eggs. Mrs. Hine reports one just beginning its nest, May 27, 1887, at Sedan. Allowing time for its completion, for laying the two eggs, which is done on alternate days, and for incubation, about fourteen days, the young would not be hatched in that nest until well towards July. The female does the nest-building, incubating, and cares for the young. They are fed by regurgitation. Major Bendire thinks two, and occasionally three, broods may be reared in a year, as fresh eggs have been found as late as August 7.

Some years they leave early in September. Last seen in Brookville, 1886, September 7; Warren County, September 16, 1897; Lafayette, 1896, September 6; September 13, 1887, at Sedan; others, they remain until near October. In 1894 they were late leaving. That year they were last seen at Plymouth, Mich., September 27; Hillsdale, Mich., September 23; Sedan, September 15; Laporte, September 28. In 1889 they remained at Brookville until September 28, and in 1897, until September 29. An instance is recorded where one was entangled in the spines of a thistle.

O. ORDER PASSERES. PERCHING BIRDS.

SUBORDER CLAMATORES. SONGLESS PERCHING BIRDS.

XXXVI. FAMILY TYRANNIDÆ. TYRANT FLYCATCHERS.

- a*¹. Tail much longer than wing; very deeply forked. MILVULUS.
- a*². Tail not longer than wing; not deeply forked.
- b*¹. Tarsus not longer than middle toe with claw; adults with a bright colored (yellow, orange or red) concealed patch on crown. TYRANNUS. 102
- b*². Tarsus longer than middle toe with claw (or else with a conspicuous cottony patch on each side of rump); adults without bright colored patch on crown.
- c*¹. Wings and tail with chestnut; length generally 8.00 or more. MYIARCHUS. 108
- c*². Wings and tail without chestnut; general color olivaceous; length 8.00 or less.
- d*¹. Wing at least six times as long as tarsus. CONTOPUS. 105
- d*². Wing about four times as long as tarsus or less; little longer than tail.
- e*¹. Wing more than 3.25. SAYORNIS. 104
- e*². Wing less than 3.25. EMPIDONAX. 106

102. GENUS TYRANNUS CUVIER.

172. (444). *Tyrannus tyrannus* (LINN.).*Kingbird.**

Synonyms, BEE BIRD, BEE MARTIN.



Kingbird.

(Beal.—Farmer's Bulletin, 54, United States Department of Agriculture, p. 11.)

Adult.—Above, blackish; top of head, black, crown with a concealed patch of orange-red; wings, dusky, the greater coverts and quills edged with white; rump and tail, black, all the tail feathers tipped and the outer ones sometimes edged with white; below, white, breast shaded with bluish-ash. *Immature*.—Lacking the orange-red crown patch, sometimes with wings and tail edged with rufous.

Length, 8.00-9.00; wing, 4.45-4.75; tail, 3.40-3.75.

RANGE.—America, from Bolivia north to Nova Scotia and Athabasca; west to Texas and Rocky Mountains, which it crosses northward and extends to Pacific coast from California to British Columbia. Breeds from Florida and Texas coast north. Winters from Florida and Gulf coast southward.

Nest, in exposed tree, usually 15 to 40 feet up, of sticks and weeds, vegetable fibre, wood, string, hair and rootlets; lined with finer material. *Eggs*, 3-4; white, creamy, or pinkish-white, spotted and blotched with various shades of brown and purple; .95 by .72.

A well known summer resident. Abundant. Breeds. The Kingbird has also been called "Bee-Bird," "Bee-Martin," and Mr. L. T. Meyer says, in Lake County, it is called, by farmers, "Dumb-Bird." Popularly, it is known as a destroyer of bees. It, with all the other members of the "Flycatcher" family, are insect catchers. That is their business, and they attend well to it. The Kingbird, and also other members of the family, are to be seen about the hives. There are many bees, both workers and drones, flying about. There, too, are flies, gnats, moths, and other insects; for there are more insects about apiaries than bees. All of these form a part of its food—of which bees other than drones form a small part.

The result of Prof. Beal's investigations of 281 stomachs of the Kingbird shows that only 14 contained the remains of honey bees. In these were 50 honey bees, 40 of which were drones; 4 were certainly workers; of 6 he was not certain. The stomachs examined contained 19 robber-flies, an insect injurious to bees, and more than an equivalent for the worker bees eaten. They do eat many wasps and native bees. Indeed, they are provided with a concealed patch of orange feathers on the crown, which, when exposed, seems to attract these insects to it, to bring its prey within easy reach. From the specimens examined, in addition to deciding its relations to the bee raiser, which certainly are not injurious, it was shown that about 90 per cent. of its food is insects, mostly injurious species; 10 per cent. is wild fruits, such as elderberries and wild grapes (Farmers' Bulletin No. 54, U. S. Dept. Agr., p. 12).

Prof. King found one bee in the stomachs of 12 Kingbirds. The principal food was beetles and flies (Geol. Wis., I, p. 559). Prof. Forbes found that 43 per cent. of the food of some examined was canker-worms (Rept. Mich. Hort. Soc., 1881, p. 204). A pair of these birds about a house serves a good purpose in driving away or giving warning of the approach of hawks and crows.

The Kingbird comes into Indiana near the middle of April, or later, and is generally seen all over the State by May 1. The following are the earliest and latest dates of first arrivals from the places named for a series of years: Brookville, April 15, 1884, latest, 1882 and 1887, both May 1; Bicknell, April 15, both 1895 and 1896, April 24, 1894; Laporte, April 18, 1896, May 4, 1893; Sedan, April 22, 1896, May 1, 1888. I have observed them mating April 30 (1884). Their nests are usually built in a tree—an orchard tree, or one in a pasture or beside a field being preferred. Twigs, weed stems, grasses and hair are generally used for the nest, which is lined with horse-hair

or other finer material. They also adapt themselves to circumstances, and use string, binder twine, cotton, wool, and other easily accessible material. I once found a nest largely composed of wool.

An egg is laid daily, and incubation lasts 12 or 13 days. Both sexes share in this and in nest-building. Two broods are sometimes reared. I have found young in nest June 19, 1896; another set of young, able to fly, July 8, 1896; old teaching young to fly, August 8, 1897. The Kingbird's song becomes less frequent, his noise noticeably diminishes, as household cares become burdensome. Only occasionally is it heard through August. They are seldom seen late in August, and early in September most have left. At Sedan, Mrs. Hine says they are usually gone by September 14. None were seen after that in 1894, except a single one, October 19.

In 1895 it remained in the vicinity of Chicago until September 25. Usually they are gone from southern Indiana by September 12. They disappear so gradually that we do not realize when all have left, and usually can not tell when we saw the last.

103. GENUS MYIARCHUS CARRANIS.

***173. (452). *Myiarchus crinitus* (LINN.).**

Crested Flycatcher.

SYNONYM, GREAT CRESTED FLYCATCHER.

Head, crested; above, decidedly olive, browner on head; wings, dusky, edged with rufous; tail feathers, dusky, with inner webs of all but the two central feathers, rufous; below, throat and chest, deep ash-gray; rest of under parts, sulphur-yellow.

Length, 8.50-9.00; wing, 3.90-4.40; tail, 3.50-4.20.

RANGE.—America, from Colombia north over N. A. east of the Great Plains to New Brunswick and Manitoba. Breeds throughout its range, north of the Gulf of Mexico. Winters from south Florida southward.

Nest, usually a cavity in a tree or stump; a miscellaneous collection of odds and ends, including rootlets, twigs, bark, moss, leaves, hair, egg shells, feathers and snakeskins. *Eggs*, 4-8; creamy or vinaceous buff, with blotches, longitudinal streaks and fine lines of different shades of brown and purple; .89 by .69.

As common a summer resident as the Kingbird, but its home is in the woods, where few hear it and fewer see it. Late in April or early in May, some morning, the bird lover will hear a penetrating "e-wheet-

whit" coming from the higher limbs of a tree in the woods. It is a last year's friend. A step into the clearing will show him on the dead limb of a dying sugar tree. A second time he greets one, and another name is added to the list of arrivals. It is the Crested Flycatcher. There is a hole, whether made by Woodpeckers I can not tell, in the top of the old forest guardian, where it sits. There it had a nest last year, and purposes to use it again this. Such is the site it prefers, but it is not extremely particular in that regard. Dr. Haymond once showed me a hollow apple tree limb where one nested in a busy part of town.



Crested Flycatcher. (Reduced.)

Mr. T. H. Barton found a nest containing 3 eggs in a half-gallon tin can along a garden fence, in town, one spring. Almost every nest found contains more or less of the cast-off skin of a snake. Both sexes assist in nest-building, in which they use leaves, grass, weeds, bark, rootlets and feathers. The female does most of the sitting, which requires about fifteen days. One egg is laid daily. But one brood is reared yearly. They are very noisy at mating time. Afterwards the noise grows less through June, and in July fails. Occasionally it is heard before leaving. September 1, 1897, I found one uttering its usual call, but not so emphatically as when a gay and careless bird, in May. They leave through August and September. The following are dates when they were last seen: Sedan, Ind., August 21, 1892; August 30, 1887; September 9, 1895; Bicknell, Ind., September 7, 1890, September 18, 1895, September 21, 1894; Warren County, September 18, 1897; Brookville, August 29, 1887, September 3, 1886,

September 1, 1897. In spring, they return closely after the Kingbird. The first spring record for the State is from Brookville, where it was observed April 18, in 1888, and 1896. It was not seen there until May 11, 1894. The following records give date of earliest and latest first arrival at places noted: Bicknell, April 19, 1896, April 24, 1895; Sedan, April 21, 1896, May 10, 1891; Laporte, April 27, 1892, May 2, 1894, and 1896; Petersburg, Mich., April 27, 1888, May 5, 1897. Its food is largely insects, with which its woodland home abounds, though, after the wild fruits begin to ripen, it eats some of them.

104. GENUS SAYORNIS BONAPARTE.

*174. (456). *Sayornis phœbe* (LATH.).*Phœbe*.

Synonym, PEWEE, BRIDGE PEWEE.

Adult.—Above, olive-gray, top of head, dark olive-brown; wings and tail, dusky, the outer tail feathers, inner secondaries, and sometimes wing coverts, edged with whitish; below, whitish, rather soiled on throat; sides of breast, olive-gray; posterior parts, tinged with yellowish; bill, black. *Immature*.—More olive above, more yellow below.

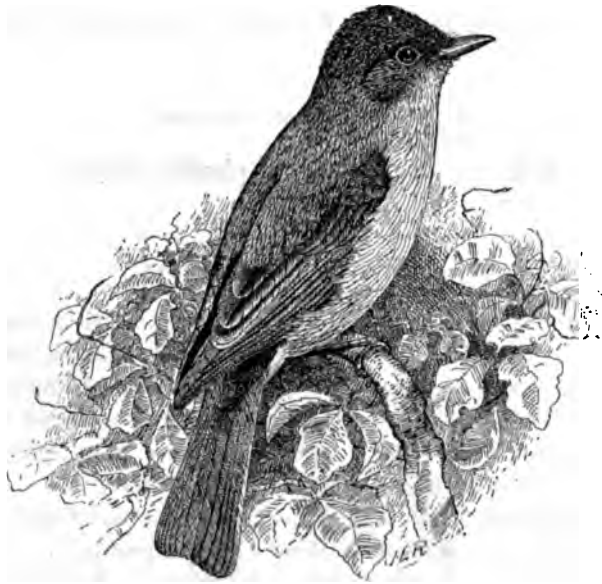
Length, 6.25-7.00; wing, 3.25-3.55; tail, 3.00-3.40.

RANGE.—Eastern North America, from Mexico and Cuba north to New Brunswick and Mackenzie River (Ft. Simpson); west to Great Plains. Breeds from South Carolina, Louisiana and western Texas, north. Winters from southern Texas, Tennessee and North Carolina, southward.

Nest, of mud, moss, grass, and feathers, under cliff, bridge, culvert or shed. *Eggs*, 3-8; white, rarely spotted with reddish-brown; .75 by .57.

One of the earliest of the summer residents to arrive is the Phœbe. Sometimes it is at Brookville by March 1, and arrives farther south late in February. It is rarely common before mid-April. The earliest arrivals seek the banks of rivers, creeks and the hillsides even in the woods. Cold days they seek the eastern exposures, where the winds do not blow and where the first rays of the sun may be felt. They are known as "Pewee," or "Bridge Bird," because of their note, which is variously given as Feebe, Feebec, or Pewee, and the place of nesting, which is often under a bridge or culvert, and also in barns, sheds, old buildings, sometimes on the post of a porch, or in the eaves of an occupied dwelling.

Their nests are still placed under the projecting rocks of a steep bank, of a railway cut, and of quarries. Thus they cling to habit, for such were their original homes. In the Falls region of southern Indiana they build beneath the Falls, protected by the shelving rocks. The summer of 1897, while on a trip through Vermillion and Warren counties, Mr. V. H. Barnett found a nest in a coal mine 20 feet from the entrance. Some years they begin mating by March 17, and nest



Phoebe.

(Beal.—Farmer's Bulletin 54, United States Department of Agriculture, p. 13.)

building by March 26. I have found their complement of eggs April 18. Sometimes a second brood is reared. The birds appear to return to the same site year after year. Incubation requires about 12 days, most of which is done by the female. The following give the date at which it was first seen, earliest and latest record, for the places mentioned: Brookville, March 1, 1881, March 29, 1892; Bicknell, March 9, 1896, March 24, 1895; Bloomington, March 2, 1893; Lafayette, March 18, 1893, April 10, 1895; Kouts, March 20, 1896; Sedan, March 16, 1889, March 30, 1896. In fall they are silent through the latter part of the summer, but just before leaving, their call may sometimes be heard. The following dates give earliest and latest departure noted for places named: Sandusky, O., Oct. 10, 1896; Sedan, Oct. 11, 1893; Greensburg, September 22, 1894, October 17, 1896; Brookville, September 28, 1885-6, October 14, 1890, and Bicknell, September 30,

1895, October 12, 1896, and October 19, 1894; which is the latest for the State. The well known severe weather in the south in the spring of 1895 must have destroyed many Phœbes. Their decrease was noted; in some localities, it was decided, that summer. By far the greater part of the Phœbe's food is insects. Few, if any, birds are of more benefit. Its work is often about the house and garden, where every effort counts in favor of man. In 80 stomachs examined, over 93 per cent. of the food was insects and spiders. The remainder was wild fruit. The insects were mainly injurious kinds, including click beetles, weevils, May beetles, grasshoppers and flies. Major Bendire says cut-worm moths is one of their favorite foods.

105. GENUS *CONTOPUS* CABANIS.

- a*¹. Wing 3.90 or over; sides of rump with a conspicuous tuft of white cottony feathers. Subgenus *NUTTALLORNIS* Ridgway. *C. borealis* (SWAINS.). 175
*a*². Wing 3.60 or less; no tuft of white feathers on sides of rump.
 Subgenus *CONTOPUS*. *C. virens* (LINN.). 176

Subgenus *NUTTALLORNIS* Ridgw.175. (459). *Contopus borealis* (SWAINS.).

Olive-sided Flycatcher.

Adult.—Upper parts, between fuscous and dark olive; wings and tail, fuscous; throat, middle of the belly, and generally a narrow line on the center of the breast, white or yellowish-white; rest of the under parts of nearly the same color as the back; under tail coverts, marked with dusky; a tuft of fluffy, yellowish-white feathers, on either flank; upper mandible, black; lower mandible, yellowish or pale grayish-brown, the tip darker. *Immature*.—Similar, but with rather more olive above, more yellow below, and with the wing coverts edged with ochraceous-buff.

Remarks.—This species may always be known from other Flycatchers by the comparatively little white on the under parts, and by the tuft of yellowish-white feathers on the flanks. Like the Wood Pewee, it has the wing .50 or more longer than the tail (Chapman, Birds E. N. A., pp. 246, 247).

Length, 7.10-7.90; wing, 3.90-4.50; tail, 2.80-3.50.

RANGE.—America, from Peru to mouth of St. Lawrence River, Great Slave Lake and Alaska. Breeds from Massachusetts, New York and Minnesota, north and south along Rocky Mountains to New Mexico and Arizona. Winters south of United States.

Nest, on a limb, 40 to 60 feet up, of rootlets, small twigs and moss. *Eggs*, 3-4; creamy-white, spotted with different shades of brown and purplish; .85 by .63.

Migrant; generally rare, but found in some numbers about the lower end of Lake Michigan. It has not been reported from the southeastern half of the State. It may breed in the northern part of the State, as Mr. E. W. Nelson took it as late as June 2, near Chicago. In that vicinity he notes it in spring, from May 15 to 25, and in fall, the last of September and first of October (Bull. Essex Inst., December, 1876, p. 113).

It appears to be a late migrant, frequenting woodland, where it is to be found upon a dead limb at the top of a tall tree. Mr. Robert Ridgway took it at Wheatland, Knox County, May 12, 1885. That is the only record from the southern part of the State. Mr. Ruthven Deane took it at English Lake, May 26, 1889, and Mrs. Hine has noted it at Sedan, Dekalb County. Mr. J. G. Parker, Jr., took a female, May 25, 1896, at Colehour, Ill. Mr. C. E. Aiken says it was not rare in Lake County in 1871, when he obtained a number of specimens. They nest late. Major Bendire says nidification rarely begins anywhere throughout their range before June 1, usually not before June 10, and in some seasons not before July (L. H. N. A. B., p. 284).

***176. (461). *Contopus virens* (LINN.).**

Wood Pewee.

Adult.—Above, dark olive-gray or olive-brown, darker on head; wings and tail, brownish-black, with an olive gloss, the former with the wing coverts edged with whitish; the latter, unmarked; white ring around eye; below, light olive gray on breast, whitening on throat; belly and under tail coverts, pale yellowish; bill, above black, below yellow. *Immature*.—Similar, but more olive above; nape, tinged with ashy; rump and upper tail coverts, with rusty; wing coverts, edged with light buff; below, lighter; forepart of lower mandible, dusky.

Length, 5.90-6.50; wing, 3.00-3.45; tail, 2.50-2.90.

RANGE.—America, from Ecuador north over eastern United States to New Brunswick and Manitoba; west to the Plains. Breeds from southern limits of United States northward. Winters south of United States.

Nest, on horizontal limb, 8 to 20 feet high, of bark, shreds, rootlets, vegetable fibre, covered with lichens. *Eggs*, 2-4; white or creamy-white, speckled and blotched with different shades of brown and purple about the larger end; .72 by .54.

A common summer resident in woods, pastures, orchards, and even about farms and other large lawns. Its note is not so sharp as the Phoebe's, and has a smooth, soothing sound that speaks of rest and contentment. The most abundant Flycatcher we have. Owing to the lateness of its arrival in spring, it is not retarded by inclement weather, but may be depended upon to come very close to the day each year. Sometimes, however, their late coming does not avail them. They are very sensitive to low temperature. The unusual cold of May 20, 1883, killed many of them. During cold weather they may sometimes be found in the thickly settled parts of our towns, probably hunting protection. At such a time, May 14, 1897, I observed one busily catching the insects about my strawberry blossoms, to many of which they were doubtless instrumental to fertilization.

It has never been reported from within our limits earlier than April 26. The fact that the Phoebe frequents woods to a considerable extent upon arrival, leads many to think that it is the Wood Pewee.

The following early and late dates of first arrival are of interest: Bicknell, April 26, 1896, May 1, 1894; Terre Haute, April 30, 1888, May 3, 1890; Brookville, May 5, 1885, May 8, 1897. They usually become common at once. Mating is observed in the latter half of May and early June. I have found the bird sitting on her nest in my yard July 9. They nest late, seldom before sometime in June. Probably occasionally a second brood is laid. Found young following old ones September 1, 1897. The shallow nest, covered with lichens, is saddled onto the horizontal lichen-covered limb of some tree; a dead limb is preferred. The nest cannot be readily told from a knot or a bunch of the covering material. This is its protection. The bird is very watchful, and never lets any one see her on the nest. By staying thereon she would make it more conspicuous. It may be seen sitting upright, preferably, on a dead limb, from which it utters its characteristic note, and alternately therewith it flies into the air to catch a passing insect. An egg is laid daily. Incubation lasts about twelve days, and appears to be performed by the female; both parents, however, care for the young. Prof. King examined 41 specimens, and found 18 had eaten 66 small beetles; 14, 41 dipterous insects; 2, a butterfly each; 9, 13 small dragonflies; 11, 29 hymenopterous insects; 1, a moth; 1, a grasshopper, and 1 a larvæ of a sawfly (Geol. of Wis., I., p. 562). He also adds that he saw a Wood Pewee capture and feed to its young, which had recently left the nest, 41 insects in 45 minutes. Some years they leave early in September; others, they remain to late October. They continue to sing to some extent until their departure. The following represent some of the extreme dates when the last were

seen: Lafayette, September 6, 1896, September 21, 1893; Greensburg, September 10, 1896, September 15, 1894; Bicknell, September 23, 1895, October 10, 1896; Brookville, September 3, 1883, October 20, 1880; Sedan, September 16, 1894, October 1, 1889; Warren County, September 25, 1897.

106. GENUS EMPIDONAX CARANIN.

- a*¹. Below distinctly yellow. *E. flaviventris* Baird. 177
*a*². Below not distinctly yellow.
*b*¹. Wing under 2.60; tail emarginated. *E. minimus* Baird. 181
*b*². Wing 2.75 or over; tail even or slightly rounded.
*c*¹. Upper parts olive green, crown about the same shade; bill pale yellow below. *E. virescens* (Vieill.). 178
*c*². Upper parts dark olive green, shaded with brownish, center of crown feathers brown; bill dull brownish below.
*d*¹. Bill larger; wing bars less conspicuous. *E. traillii* (And.). 179
*d*². Bill smaller; wing bars more conspicuous.
E. traillii alnorum Brewster. 180

*177. (463). *Empidonax flaviventris* BAIRD.

Yellow-bellied Flycatcher.

Above, olive-green, somewhat darker on the crown. Wings, dark brown, crossed with two bands, and secondaries edged with yellowish-white; tail, brown, edged with olive-green; yellow ring around eye. Below, yellow, the fore parts tinged with pale olive-green; the back parts, dull sulphur-yellow; bill, above, blackish; below, yellow or whitish.

Length, 5.10-5.80; wing, 2.40-2.75; tail, 2.00-2.30.

RANGE.—Eastern North America, from Panama to Labrador and Northwest Territory; casually to Greenland. West to Manitoba and Minnesota. Breeds from Massachusetts and Pennsylvania northward. Winters south of United States.

Nest, on ground, of moss and rootlets. *Eggs*, 4-5; dull white, with fine markings of brown; .67 by .51.

Dr. Coues gives the following synopsis for the identification of the eggs of the small flycatchers:

"*E. acadicus*—Nest, on the trees, in horizontal forks, thin, saucer-shaped, open-work; eggs, creamy-white, boldly spotted.

"*E. traillii*—Nest, in trees, in upright crotch, deeply cupped, compact walled; eggs, creamy-white, boldly spotted.

"*E. minimus*—Nest, in trees, in upright crotch, deeply cupped, compact walled; eggs, immaculate white.

"W. flaviventris—Nest, on ground or near it, deeply cupped, thick and bulky; eggs, white, spotted."

Rare migrant, and occasional summer resident. Breeds. This species is retiring and quiet, and with us is rather silent. Occasionally, it utters a queer, wheezing note, which Mr. J. Dwight, Jr., says (in Chapman's Birds of E. N. A.) is suggestive of a sneeze, and which he writes *pse-ek*, uttered almost in one explosive syllable. Its call, he says, is a soft, mournful whistle, consisting of two notes, the second higher pitched and prolonged, with rising inflection, resembling a measure "*chu-e-e-p*."

It has been first observed at Bloomington, April 17, 1886, May 7, 1892; Bicknell, May 1, 1894; Richmond, May 8, 1897; Greensburg, May 14, 1894; Davis Station, May 18, 1884, May 31, 1885; Sedan, May 21, 1888; Lake County, May 16, 1877; Petersburg, Mich., May 8, 1897. Mr. J. G. Parker took a male June 3, 1889, on one of the knobs near New Albany. Dr. F. W. Langdon notes a specimen taken at Madisonville, O., May 28, 1879 (J. C. S. N. H., Dec., 1881, p. 340).

Mr. E. A. Colby shot several July 23, 1887, at Berry Lake, Lake County, Ind. (Coale). Mrs. Jane L. Hine thinks it bred in Dekalb County. Mr. E. W. Nelson says: "The first of July, 1873, I found them quite common in a dense, swampy thicket in northern Indiana, where they had probably nested" (Bull. Essex Inst., Dec., 1876, p. 114). Its time of mating and nesting is late. The second or third week in June, or even later, is the time they lay. Their southward migration is in August, and rarely extends into early September. Mr. E. M. Kindle took one at Weed Patch Hill, Brown County, August 11, 1891 (Proc. I. A. S., 1894, p. 70); Cook County, Ill., August 25, 1886; Hillsdale, Mich., August 24, 1894, two. The nest is composed principally of moss, and is placed on or near the ground.

***178. (465). *Empidonax virescens* (VIEILL.).**

Green-crested Flycatcher.

Synonyms, ACADIAN FLYCATCHER, SMALL GREEN-CRESTED FLYCATCHER.

Adult.—Above, olive-green, sometimes greenish-gray; wings, dusky; two wing bars, and edges of secondaries, buffy or buffy-white; tail, olive-brown, feathers edged with olive-green; ring around eye, yellowish-white. Below, whitish, tinged with sulphur-yellow, shaded on breast with grayish or olive; throat, whitish. Lower parts, not dis-

tinctly yellow, as in *E. flaviventris*; bill above, brown, below whitish. *Immature*.—Above, with indistinct cross bars, wing bars and edging more ochraceous.

. Length, 5.50-5.90; wing, 2.55-3.10; tail, 2.25-2.70.

RANGE.—America, from Ecuador north over eastern United States to southern New England, southern New York, Pennsylvania, southern Michigan, Wisconsin and Manitoba. West to Great Plains. Breeds from Florida and eastern Texas northward. Winters south of United States.

Nest, in woods, shallow, pensile, fastened by rim in fork of drooping limb; 4 to 20 feet up; of rootlets, grass, weeds, stems and plant fibres. *Eggs*, 2-4; pale cream to buff, spotted and speckled with light and dark brown; .79 by .58.

The Acadian Flycatcher is a resident throughout the State; in many localities it is very common, and is always more numerous during migrations. It frequents woods, but is also found in orchards, and lawns. It, too, arrives late, usually after May 1, and becomes common at once.

The early and late dates of first appearance at the following places, is Brookville, May 4, 1882, May 18, 1883; Greensburg, May 2, 1894, May 4, 1893; Sedan, May 1, 1896, May 17, 1892; Chicago, May 9, 1885. In the immediate vicinity of Chicago it is rare, but in the Kankakee Valley it is common. It has been reported as breeding in the following counties: Carroll, Dekalb, tolerably common; Lake, Tippecanoe, Brown, Decatur, Vigo, Starke and Monroe.

Mating begins in May; the nest is often ready for the eggs the middle of May, near the Ohio River, and early in June towards Lake Michigan. The nest is woven in the fork of a drooping branch of a tree, seldom over 15 feet from the ground. An egg is laid daily. Dr. F. M. Langdon found several nests, with full complement of eggs, near Madisonville, O., May 29, 1879 (J. C. S. N. H., Dec., 1881, p. 340). June 8, 1878, Mr. H. K. Coale took a nest and two eggs, at Whiting, Lake County. June 8, 1884, he took a nest and three eggs in Starke County. June 15, Prof. B. W. Evermann took full sets in Carroll County. Messrs. L. A. and C. D. Test found a nest, with young, near Lafayette, June 29, 1892. The same young gentlemen found a nest, containing three eggs, on the bank of the Wabash River, July 9, 1892. Mr. Coale found a nest of this species at Berry Lake, June 16, 1878, which was attached to a slender twig by one side only. It was made entirely of fine, curling trailers growing on the tree, woven neatly into a shallow nest. Externally, it was one inch deep, two and a half inches in diameter. Two eggs could be seen through

the nest from below. It usually begins its return in August, but sometimes is seen after the middle of September. The following give last records of its occurrence: Plymouth, Mich., August 29, 1894; Chicago, September 22, 1895; Lafayette, September 12, 1895, September 16, 1894; Sedan, August 28, 1892, September 3, 1889. Mr. V. H. Barnett shot young that could not fly well in Warren County, September 25, 1897. Maj. Bendire gives its call as *wick-up*, or *hick-up*, interspersed now and then with a sharp *queep-queep* or *chier-queep*, the first syllable quickly uttered. This is one of our very beneficial birds. Its food is chiefly insects. Dr. B. H. Warren examined the stomachs of 7; 2 contained beetles; 1, beetles and flies; 1, large flies and larvæ; 2, various insects; 1, berries (Birds of Penn., 2nd ed., p. 196).

***179. (466). *Empidonax traillii* (AUD.).**

Traill's Flycatcher.

Synonym, LITTLE FLYCATCHER.

Adult.—Above, brownish-olive, or olive-gray, darker on the head; wings and tail, dark brown, the former with two bands, varying from whitish to dark buffy; secondaries, edged with same; white or yellowish-white ring around the eye. Beneath, white, the sides of breast, and sometimes across the breast, shaded with the color of the back, or grayish; sides, throat and crissum, pale, tinged with sulphur-yellow; bill, above, brownish-black; below, white or yellowish. *Immature*.—Wing bands, ochraceous.

Length, 5.60-6.50; wing, 2.55-2.85; tail, 2.20-2.60; bill, .64-.73 tarsus, .65-.72.

RANGE.—North America, from Mexico to Manitoba; Mackenzie River Valley, and Alaska. East to Arkansas, Illinois, Ohio, Michigan and Indiana. Breeds from Texas and California northward. Winters south of United States.

Nest, in open woods, and second-growth thickets, preferably near water courses; in upright fork of bush, 18 inches to 8 feet up; of grass, vegetable fibres, cobwebs and leaves; lined with fine grass, horsehair and plant down. *Eggs*, 3-4; creamy-white, variously marked with minute dots, spots, or large blotches, with varying shades of red, reddish-brown; and sometimes lavender, principally at large end; .77 by .56, .70 by .52; average, .74 by .54.

Summer resident, generally distributed, and locally common. Breeds. In the Whitewater Valley it has never been found common. It has been found breeding in Laporte (Barber) and Tippecanoe counties (Test Bros.), and is thought to nest in Lake and Dekalb counties.

In Monroe County, Prof. Evermann found it an uncommon summer resident, and in Carroll County he took it June 10, 1885. They are usually later than the last species in arriving.

The following dates show time of its first arrival: Brookville, May 9, 1887, May 19, 1882; Davis Station, May 31; Laporte, May 30, 1896; Lafayette, April 28, 1897; Plymouth, Mich., May 11, 1882, May 20, 1895. Messrs. L. A. and C. D. Test found a nest, containing three eggs, just north of Purdue University grounds, Lafayette, Ind., July 4, 1892. The nest was about 12 feet from the ground and about 6 feet above it was another deserted nest.

Traill's Flycatcher is the opposite of the Acadian in several respects. It does not prefer the woods, but rather thickets, especially of alders, in low, damp ground, the borders of streams and lakes. It also is found in orchards. Its nests are usually placed in the crotch of a bush 25 feet or less above the ground, and, instead of being loosely-woven affairs like the nests of the last species, are thicker and better made, reminding one of the nest of the Yellow Warbler, but not so compact. In Wayne County, Mich., where it nests commonly, Mr. Jerome Trombley, who has found twenty-five or thirty nests for several consecutive years, says they nest in communities in willows by marshes; nest in fork of a bush from three to six feet high (Cook, Birds of Mich., p. 97). Mr. Otto Widmann says its notes sound like, *wit-tit-che*, *wit-ti-go*, and are uttered when the bird is perched on the top of a sprout or low tree, a telegraph post, or a fence stake.

Full sets of eggs are found after the middle of June. An egg is deposited each day; one brood is raised in a year. Incubation lasts about twelve days. They return to their winter home in August and early September. The following dates indicate the range of this migration: Brookville, August 13, 1881; Plymouth, Mich., August 8, 1892, September 3, 1895. It is impossible to tell at this time to what extent the eastern and western forms of this Flycatcher are found in Indiana.

180. (466a). **Empidonax traillii alnorum** (BREWST.).

Alder Flycatcher.

Differing from *E. traillii* (i. e., *E. pusillus* of Baird and subsequent authors) in having the coloring of the upper parts richer and more olivaceous, the wing bands yellower, and hence more conspicuous, the bill decidedly smaller and the legs rather shorter (The Auk, April, 1895, p. 161, Brewster). Bill, .60-.64; tarsus, .64-.67.

RANGE.—Eastern North America, from the Maritime Provinces and New England westward, at least, to northern Michigan, etc., breeding from the southern edge of the Canadian fauna northward; in winter south to Central America (A. O. U.).

Nest, preferably in alder swamps and thickets, usually in crotch in bush, 1 to 6 feet up; of grasses, vegetable fibre and bark shreds, lined with fine grass, fibre or hair. **Eggs,** 2-4; from creamy-white to pinkish-buff, with spots and blotches of reddish-brown, usually thickest about the larger ends; .73 by .53.

It is doubtful whether it is proper to attempt to separate this from the western form, *E. traillii*, in view of the fact that it is practically impossible to distinguish the birds by the aid of a description. To conform to existing conditions, however, I have included this form.

Summer resident. Mr. Wm. Brewster considers that specimens from the Mississippi Valley, south of latitude 42°, belong to the western form of Traill's Flycatcher. This extends its range farther east than was heretofore supposed, and undoubtedly includes a part, if not all, of Indiana. The eastern form has been given the name, *Empidonax traillii alnorum*, and the fact that it ranges west to northern Michigan, and has been taken in Ohio (Lynds Jones in *The Auk*), makes it probable it is also found within this State. He has shown it necessary to drop the name *pusillus* for that form because it can not be identified.

Audubon's *Muscicopa traillii* was described from an Arkansas specimen, which Mr. Brewster thinks is of the western form. The name *E. traillii* will be used for that bird.

***181. (467). *Empidonax minimus* BAIRD.**

Least Flycatcher.

Adult.—Above, olive-brown or olive-gray, slightly darker on head, lighter on rump; wings and tail, brownish, the former with two whitish cross-bars, and secondaries edged with same; ring around the eye, white. Below, throat white, sides of throat sometimes extending across breast, gray or olive-gray; other under parts, white, tinged (sometimes very faintly) with sulphur-yellow. **Immature.**—Wing bars, ochraceous.

Length, 4.90-5.50; wing, 2.20-2.60; tail, 2.10-2.40.

RANGE.—Eastern North America, from Panama to Nova Scotia, Cape Breton, Great Slave Lake, and Mackenzie River Valley (Ft. Simpson), west to Rocky Mountains, casually to Utah. Breeds from North Carolina, northern Indiana and Nebraska northward. Winters south of United States.

Nest, in orchards, thickets and woods, in upright fork or on horizontal limb; of shreds of bark, grass, plant fibres, vegetable down, feathers, string, etc.; lined with fine down and hair. *Eggs*, 3-6; pale creamy-white; .64 by .50.

Rather common migrant southward. Summer resident in some numbers northward. It arrives earlier than the species just mentioned, sometimes by April 20. It is the smallest of the Flycatchers, and may readily be distinguished by its size. It is called, in many places, Che-bec, from its note, which is very distinctly "*che-bec*." It is to be found most often in straggling woods, along the edges, and about roads through woodland, and in strips of woods along hill-tops. With us, I have generally found it upon the higher land, where it is very quiet, seldom saying anything, and then only uttering a sharp "whit." It industriously pursues flying insects, and even when one does not see it he is reminded of its presence by hearing the snap of jaws as it seizes its prey.

The earliest and latest date of its first appearance is, at Brookville, April 24, 1886, May 8, 1882; Bloomington, May 3, 1892; Richmond, May 22, 1897; Sedan, April 20, 1889, May 3, 1885; Lake County, May 16, 1877 and 1880; Chicago, May 5, 1879, May 23, 1896. It has been reported breeding in Lake County and in Dekalb County. Mr. J. O. Snyder found a nest, with fresh eggs, near Waterloo, June 3, 1885. Prof. B. W. Evermann says it is a summer resident, not common in Carroll County. Its disappearance in fall occurs in late August and September. It was last reported at the following places: Brookville, August 31, 1883; Cincinnati, O., August 27, 1879; Sedan, September 7, 1889; Chicago, Ill., September 30, 1895; Bicknell, September 18, 1895. Its small size does not prevent it from doing great good. Its food is principally the smaller insects and occasionally a little fruit.

Prof. F. H. King says the examination of 23 showed they had eaten 30 beetles, 18 diptera (flies and gnats), 2 heteroptera, 37 winged ants, 2 small ichneumon flies, 3 caterpillars, 1 moth, 4 small dragonflies and 1 spider (Geol. of Wis., p. 562).

This is the only one of the little Flycatchers that tries to sing; at least, that attempts what to my ears bears some resemblance to music. It has a little song, that one may occasionally hear it try to sing, that is quite a credit to a Flycatcher.

SUBORDER OSCINES. SONG BIRDS.

XXXVII. FAMILY ALAUDIDÆ. LARKS.

- α^1 . Small tuft of lengthened black feathers over each ear (sometimes obscure in female.) OTOCORIS. 107

107. GENUS OTOCORIS BONAPARTE.

- α^1 . Larger; wing generally over 4.30; forehead and line through eye yellow. **O. alpestris** (Linn.). 182
 α^2 . Smaller; wing generally under 4.30; paler colored; forehead and line over the eye white. **O. alpestris praticola** Hensh. 183

182. (474). **Otocoris alpestris** (LINN.).**Horned Lark.**

Synonym, **SHORE LARK.**



Head of Horned Lark.

Adult, Summer Plumage.—Above, grayish-brown; nape, lesser wing-coverts and rump and upper tail-coverts, deep vinaceous; forehead, line over the eye and throat, sulphur-yellow; band across breast, stripe from bill below the eye and band across the top of head, above the eye extending backward along the side of crown, ending in tufts or horns, black; other lower parts, white; dusky along the sides; tail, black, the outer feathers edged with white, the middle one with brown; wings, brown. *Winter Plumage.*—Paler, the black markings somewhat obscured by lighter. *Female.*—Smaller; black on head less distinct.

Male.—Length, 7.50-8.00; wing, 4.20-4.60; tail, 2.70-3.10; bill (average), .50. *Female*, wing, 3.95-4.55; tail, 2.50-3.10.

RANGE.—Northeastern North America, from North Carolina, Ohio, Indiana and Illinois (formerly farther south); north to Hudson Bay

and Greenland; west to Keewatin and western side of Hudson Bay. Also, north Europe. Breeds from New Foundland, Labrador and Keewatin northward.

Nest, on ground, of grass, lined with vegetable fibre and feathers. *Eggs*, 3-5; similar to those of next form; .94 by .66.

This species is occasionally found within the State in winter, but owing to the fact that but few persons are interested sufficiently to have a critical investigation made, we can not tell how extensive its range or how numerous it is. We know, however, that it is an occasional winter visitor to Indiana. Mr. G. Frean Morcom took a specimen at Davis Station, Starke County, which Mr. Ridgway identified as this bird.

Mr. H. K. Coale obtained six specimens of this lark at Tracy Station, Ind., Feb. 10, 1887. Dr. J. Dwight, Jr., has given an exhaustive analysis of the Horned Larks of America in "The Auk" for April, 1890, pp. 138-158, to which one who is interested in the subject may profitably turn. In that article he mentions a specimen of this species from Mt. Carmel, Ill., in the lower Wabash Valley, indicating that it may be found in winter over the greater part of this State. Its habits are similar to those of the more common Lark at that season.

***183. (474b). *Otocoris alpestris praticola* HENSIL.**

Prairie Horned Lark.

Synonym, SHORE LARK.

Adult.—Similar to *O. alpestris*; smaller; paler, back, gray; nape, lesser wing-coverts, rump and tail-coverts, pale vinaceous; forehead and stripe over eye, white or whitish. *Immature*.—Darker; much streaked and spotted.

Length, 6.75-7.50.

Male.—Wing, 4.00-4.30; tail, 2.90-3.10; bill, .45. *Female*.—Wing, 3.70-4.00; tail, 2.60-2.90; bill, .45.

RANGE.—Eastern North America, from central Texas and South Carolina north to Maine, Ontario and Manitoba. Breeds from eastern Kansas, Missouri, southern Indiana, Ohio and southern New York to Massachusetts north.

Nest, in depression on ground, of grass, lined with thistle-down and feathers. *Eggs*, 3-5; drab-gray to grayish-white; sometimes tinted with greenish; blotched and sprinkled with different shades of pale-brown; .85 by .62.

Resident, common northward, except in the extreme northern part; most numerous in winter, when it is found in flocks. There the greater part are usually absent from December 1 to January 25, but occasionally, late seasons, they do not appear until early in March. First observed at Sedan, January 25, 1894; Cook County, Ill., March 14, 1885, and March 6, 1886; February 22, 1888; Petersburg, Mich., January 22, 1889. They utter a lisping note of varying inflection, sometimes, when on the ground, always when flying. They frequent pastures, meadows, stubbles and fields of winter grain. When snow is on they are often seen where stock has been fed outdoors, and about barnyards. From southern Indiana the greater number go north in late January and early May. Some, however, remain through the year. They are evidently gradually extending their range as the country is more and more brought under cultivation.

Mrs. Hine says they are increasing in Dekalb County. Prof. B. W. Evermann says up to 1879 it was very rare in Carroll County, but in 1886 it was a common resident. I never saw one after late February in Franklin County until 1886, when they remained until after breeding time. In 1891 they bred; young were found June 21, and since then they have been present yearly.

It is the earliest of our small birds to breed. Prof. Cook notes that its eggs have been taken at Plymouth, Mich., in February, and Mr. L. W. Watkins took them March 20, 1889, presumably at Manchester, when the nest was surrounded by snow. Usually, however, with us it nests in March and early April. The nest is placed in a depression in the ground, either natural or made by the bird itself. Sometimes it is composed of but a few sticks or straws, and lined with thistle-down or feathers. At this time they sing a beautiful song, but so fine and weak that it can scarcely be heard 200 feet away, and of such ventriloquial effect one can not tell whether the singer is on the ground or in the air. Generally he will be found on a fence or a clod, but sometimes in midair, with feathers erected and full of emotion, which he expresses in his song. This song I have heard at Brookville, March 31, 1896.

They breed abundantly in Lake County, and they have been found breeding as far south as Bloomington, Spearsville, Greensburg, Richmond, Brookville and Bicknell. L. A. and C. D. Test found young able to fly at Lafayette, April 25, 1893. I found them at Brookville, June 21, 1891. Dr. A. W. Brayton says the young are fully-fledged in May; the male takes care of these and the female resumes her work on a second set of eggs (Trans. Ind. Hort. Soc., 1879, p. 102). Sometimes a third brood is reared, according to Prof. Walter B. Bar-

rows. Both birds assist in incubation, which takes about fourteen days. They must lay sometimes in February and March. April 24, 1878, Dr. Brayton shot, near Indianapolis, a number of Shore Larks, among them two young birds about grown (Bulletin Nutt. Orn. Club, 1878, p. 189).

Its food consists principally of seeds of different grasses, like those of pigeon, foxtail and Hungarian (*Setaria*); also of those of different species of *Polygonum* (bindweed, knotweed and smartweed), those of the ragweeds (*Ambrosia*), pigweed (*Chenopodium*), etc.

Broken kernels of oats and other grains have also been found in their stomachs, evidently picked up in the roads and streets among the droppings of horses. During spring and summer, when small insects abound, a portion of their food consists of young locusts and grasshoppers, small beetles and their larvæ, and hairless caterpillars, and the young nestlings, at least, are fed on insect food. From an economic point of view, all our Horned Larks must be considered as useful birds, doing far more good than harm (Bendire, L. H. N., A. B., II., p. 335).

The little harm they do is more than balanced by the destruction of weed seeds and of injurious insects.

XXXVIII. FAMILY CORVIDÆ. CROWS, JAYS, MAGPIES.

- α^1 . Tail not shorter than the short rounded wings. (Subfamily GARRULINÆ.)
- b^1 . Tail much longer than wing; graduated for half its length; head not crested. PICA.
- b^2 . Tail much longer than wing, not graduated for half its length.
- c^1 . Plumage chiefly blue; head with a conspicuous crest. CYANOCITTA. 108
- c^2 . Plumage not blue; head not crested. PERISOREUS.
- α^2 . Tail much shorter than the long pointed wings. Subfamily CORVINÆ.
- d^1 . Plumage glossy black. CORVUS. 109

SUBFAMILY GARRULINÆ. MAGPIES AND JAYS.

108. GENUS CYANOCITTA STRICKLAND.

*184. (477). *Cyanocitta cristata* (LINN.).

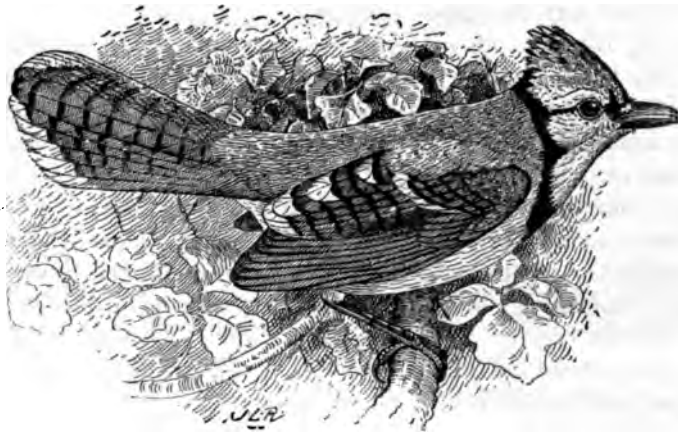
Blue Jay.

Adult.—Conspicuously crested; above, purplish-blue; forehead and irregular band around neck, black; wings and tail, blue, barred with black; the greater coverts, secondaries and tail feathers, except middle one, tipped with white; tail, much rounded. Below, pale gray; throat, belly and crissum, whiter.

Length, 11.00-12.50; wing, 5.00-5.70; tail, 5.05-5.70.

RANGE.—Eastern North America, from Florida and Texas coast north to New Foundland and Hudson Bay, latitude, 56°, west to Great Plains. Breeds throughout its range, except Florida, Gulf coast and central Texas.

Nest, bulky; in trees, of twigs, bark, moss, paper, strings, grass, and sometimes mud, and lined with rootlets and other fine material. **Eggs,** 3-6; cream, buff, or greenish, irregularly spotted and blotched with different shades of brown and lavender, generally heaviest about larger end; 1.10 by .81.



Blue Jay.

(Beal.—Year Book United States Department of Agriculture, 1896, p. 197.)

A common and well-known resident. In the northern part of the State, some of them migrate over winter. Through the winter, aside from the well-known call, *jay, jay*, or *caw, caw*, is heard, but as spring approaches they become very vocal, uttering many calls, some very pretty notes, varying from loud to very low. Evidently some of the latter are intended solely for one female to hear, and when the pair is surprised they slip away and, with apparent indifference, repeat some rollicking role from a near-by tree. *Keo-e-yeo* is the familiar call, while one of the best-known low ones is, *we-hue*. They are quite good imitators of some birds.

With us, this season of song begins early in March. In 1893 as early as March 8, and in 1897, March 9. With it comes pairing time, which I have known to continue until April 25. I have known them to begin building as early as March 16, 1897, and have found them just beginning a nest May 11, 1881. I have found eggs from April 4 to May 21, and the young left the one containing eggs April 4, on May 20.

Prof. W. P. Shannon has found eggs beginning to hatch (April 27). According to data, which he kept in 1896, a nest was begun April 1, the first egg laid April 17; an egg was laid each day, the fourth and last April 20; sitting began April 21, and the young were hatched May 2. That would make the period of incubation 12 days. Major Bendire says it is fifteen or sixteen days. Both sexes assist, and usually but one brood is reared. They use whatever is handy for nest-making. If in the woods, twigs, grass, leaves, bark, and sometimes mud is employed. About houses, strings, rags, paper, and almost anything in the way of odds and ends is used. It is usually placed from 10 to 20 feet high in a tree.

The Jay is pretty; his song and his queer ways are interesting, but every one has something against him. He is quarrelsome, teasing, persecuting and murderous, at times. Yet again he will live at peace with a mixed company of good birds in a town yard, as he has done for years in mine, becoming, instead of the shy, hiding bird of the woods, a companion of the chickens when feeding-time comes. The Jay does so many unexpected things that I, long ago, concluded not to be surprised at anything he does. I have no doubt that many Jays are bad. Individuals or pairs are depraved, and in spring rob other birds of their eggs or young. In fact, I knew of a case in town in which they robbed the nest of a robin of its eggs. But we hear of such outrages and the good it does goes by unknown.

Investigations made show that the charges against the Jay are true, but that they are not so extensive as one would suppose, and that there is another column in the account in which should be given the credit due. The United States Department of Agriculture reports the investigation of 292 stomachs. Shells of birds' eggs were found in three, and the remains of young birds in two. They eat mice, fish, salamanders, snails and crustaceans; altogether, a little over 1 per cent. of their food. Of harmful insects, they eat a little over 19 per cent. In August, nearly one-fifth of its food is grasshoppers; 19 per cent. of their food was cereals; 70 stomachs contained corn, most of which was eaten in the first five months of the year; 8, wheat; 2, oats. Mast formed the principal food. This (acorns, chestnuts, chinquapins, etc.), was found in 158 stomachs, over 42 per cent. of the whole food. Wild fruits were also eaten. The Jay eats many harmful insects. It does not destroy as many birds' eggs and young as was supposed. It does little harm to agriculture (Beal, *Farmers' Bulletin*, No. 54, pp. 14, 15).

Prof. F. H. King found, out of 31 specimens examined, one had killed three young robins; 15 had eaten 30 beetles; 2, 2 caterpillars; 2, 2 grubs; 1, other larvæ; 2, grasshoppers; 5, corn; 1, wheat; 1, berries,

and 19, acorns. This and other investigations that have been made bear out the testimony of Prof. Beal. In my own yard I find young poison vines (*Rhus toxicodendron*), springing up in number everywhere. These I ascribe to seeds dropped by birds, and I am inclined to lay the charge to the Blue Jay.

The Jay is one of those birds which by reason of its great range of food it is desirable to preserve, if it does not become more destructive, for it is liable to be of great service some day against any unusual insect outbreak.

SUBFAMILY CORVINÆ. CROWS.

109. GENUS CORVUS LINNÆUS.

a¹. Wing over 16.

C. corax sinuatus (Wagl.). 185

a². Wing under 14.

C. americanus Aud. 186

***185. (486). *Corvus corax sinuatus* (WAGL.).**

American Raven.

Adult.—Plumage, entirely lustrous black, with purplish reflections; feathers of neck, disconnected, long, narrow and pointed; bill and feet, black; iris, brown; tail, conspicuously rounded.

Length, 25.00-27.00; wing, 16.10-18.00; tail, 9.00-11.00; bill, 2.40-3.05.

RANGE.—North America, from Guatemala to British Columbia, Ontario and Maine. In the eastern United States, now rare and principally confined to the mountainous districts, along which it ranges to South Carolina, Georgia and Alabama. Usually resident where found.

Nest, on cliffs or in trees, of sticks and bark; lined with hair, wool or moss. *Eggs*, 5-7; pale-green, drab or olive-green; much blotched or spotted with different shades of brown, lavender and drab; 1.95 by 1.29.

Rare resident. Breeds. I had supposed the Raven was extinct in southern Indiana, and but few were found in the northern part of the State. In April, 1897, Mr. Chansler informed me that two persons had spoken to him of its nesting in Martin County, in cliffs, and that one of them said he had taken a nest and two eggs in 1894. Mr. Cass. Stroud, of Wheatland, says Ravens are moderately common in a locality known as "Ravens' Hollow," five miles south of Shoals, Martin County. Mr. Chansler also said that one person told him of their nesting at "Ravens' Rock," in Dubois County. Mr. Geo. R. Wilson, Coun-

ty Superintendent of Schools, Jasper, Ind., has very kindly made inquiries on this subject in Dubois County. He knows of his own knowledge that Ravens were found in that county up to five years ago. "Ravens' Rock" is a sandstone cliff 75 or 80 feet high, the top of which projects about 33 feet. It is situated between Dubois and Ellsworth. Two school teachers from that neighborhood have, by Mr. Wilson's request, investigated the question of its breeding there, and the following is the substance of their report. In the cliff are shelves, very difficult to reach, and on those, or, rather, in the crevices, the Ravens build their nests, or did so until very recently. These nests were rough, made of large weeds, or even sticks, with hair or wool. The Ravens have not been noticed there this year, but were a year or two ago, and regularly previous to that. They look very much like a crow, but are very much larger, even two feet from bill to tip of tail, which is round in shape. They have been seen to eat rabbits, and some say to "suck eggs." Neighbors do not like them, and look upon them as a sign of "bad luck." They were often seen five miles from the rock, and were known by their harsh croak. They fly very high. They may still be found in other southern counties of the State. From northern Indiana, however, I have no recent record. Mr. C. A. Stockbridge reported them as not uncommon in the eastern part of Allen County the winter of 1890-91. Mr. J. E. Beasley said, in 1894, it was a rare winter visitor in Boone County. He informs me none have been seen there since. Dr. A. W. Brayton, in 1879, said: "It frequents the sandhills along the shores of Lake Michigan from October until spring, eating the dead fish thrown up by the lake." (Trans. Ind. Hort. Soc., 1879, p. 129). Mr. C. E. Aiken informs me he saw it in Lake County in 1871. The opinion in southern Michigan is that this bird has been replaced by the crow, that the Raven was common there up to 35 or 40 years ago, and steadily faded out before the smaller species (Cook, Birds of Mich., p. 100).

So far as I can learn, the last Ravens were seen in Franklin County in 1868. I know of no records later for any part of southeastern Indiana. Throughout portions of the western United States they are still common. Major Bendire says of it: "Although a good deal has been written reflecting on the Raven, my personal observations compel me to consider it a rather orderly member of a somewhat disreputable family group." He further says: "Their ordinary call-note is a loud 'craak-craak,' varied sometimes by a deep grunting, 'koerr-koerr,' and, again, by a clucking, a sort of self-satisfied sound, difficult to reproduce on paper; in fact, they utter a variety of notes when at ease and undisturbed" (L. H. N. A. B., II., p. 397).



HARROWS & SCHWARTZ, Bull. No. 6, Div. of Ornith. and Mamm., U. S. DEPT. OF AGR.
AMERICAN CROW.

186. (488). *Corvus americanus* AUD.*Common Crow.****Synonyms, CROW, AMERICAN CROW.**

Adult.—Plumage, uniform black, with violet gloss; feathers on neck, short, rounded, not disconnected from others; bill and feet, black; iris, brown; tail but slightly rounded.

Length, 18.50-19.50; wing, 13.00-13.50; tail, 6.90-8.00; bill, 1.80-2.05.

RANGE.—North America, from Mexico north to Labrador, Hudson Bay to Anderson River (lat. 68°) and Alaska. Breeds throughout its range, except Florida.

Nest, in trees; of sticks, weeds, grass, leaves, lined with grass, wool, hair and other finer material. *Eggs*, 4-8; bluish-green, olive-green or olive-buff; irregularly blotched and spotted with different shades of brown and gray; 1.63 by 1.15.

Very common throughout the State; resident, but not so common in winter northward. They are partially gregarious, collecting in colonies, called "roosts," in October and November and breaking up in March. During the day they range widely from these roosts, and at night return to them. Sometimes these "roosts" are maintained for years at the same place; again, they change their location often. The roosts vary much in size; some of the larger ones being estimated to contain 100,000 to 300,000 crows. The following roosts have been reported from Indiana: (1) One in Wayne County, changed several times, locations given as $1\frac{1}{2}$ to 10 miles from Richmond; a roost near Boston, that county, may be one of the sites of the same birds (W. S. Ratliff). (2) In Rush County, in a soft maple swamp near Milroy, has been there "always." Most numerous in late summer, at "roasting-ear" time, when farmers have to fight them to save their corn; sometimes found there by the thousands (Lon Innis). (3) In Turner's Grove, near Bloomington, quite extensive (W. S. Blatchley). (4) One near Terre Haute (W. S. Blatchley, J. T. Scovell). (5) One in Shelby County, between London and Brookfield, has been there for the past four winters (J. G. Perry). There was one for 6 or 7 years near Fairland, in a grove of about 15 acres' extent. Five or six years ago the boys disturbed them, and they left and located 4 or 5 miles southwest of the old site (Willard Fields). As I understand it, this new site is the same one mentioned by Mr. Perry. (6) One near Irvington, several years ending with 1893 or 1894 (G. S.

Cottman). (7) One near Brown's Valley, Montgomery County, not large (J. S. Wright). (8) One about three-quarters of a mile north of Camargo, Ill. Tens of thousands roost in a scrub-oak grove. It is said Crows from there range nearly or quite across the first two tiers of counties of Indiana east of that point. Twenty or thirty years ago, it is said, they flew from the roost to Terre Haute, Vigo County; Armiesburg and Montezuma (Parke County), and Clinton, Vermillion County, for their morning feed upon the refuse of slaughter-houses, which then existed at each place. (9) Probably 500 birds roost at night in the two cemeteries at Vincennes through the winter (J. A. Balmer, 1889). (10) Mr. R. R. Moffitt reports a Crow Roost at Slim Timber, White County, about 12 miles west of Brookston and 21 northwest of Lafayette. He estimates 100,000 Crows winter there. In the southern part of Franklin County crows are noted flying in a southeastern direction, as though a roost existed in that direction in Ohio (H. F. Bain). The following account of the roost near Irvington was written by Mr. W. P. Hay, February 24, 1890, and is published in Bulletin No. 6, Div. of O. and M., U. S. Dept. of Agr., pp. 18, 19.

"For several years the Common Crow has been very abundant about here, especially in winter. Every morning at about half past 5 a great string of Crows, extending as far as the eye can reach, can be seen flying toward the south. At about 4 o'clock in the evening they return. On the 15th of February I visited a roost which is situated about 2 miles north of here. It is in a thick beech wood of perhaps 50 acres. I reached the place at about half-past 4, and in a few moments the Crows began to arrive. They came in five 'streams'—from the north, northeast, northwest, south and southeast. Soon the trees were black with them, and the noise they made was almost deafening. After being shot at several times, they all congregated in one corner of the wood, and when shot at again left the trees and settled on the ground in the neighboring fields. They were now so badly scared that it was impossible to get within gunshot: so, throwing myself upon the ground, to be as near as possible out of sight, I began to imitate, as well as I could, the cawing of the Crow. Almost immediately they answered, and every crow in the field came circling over me. At first they were perhaps 200 feet in the air. They all would caw as loudly as possible for perhaps a half-minute, then they would be still. If answered, they would come lower and caw again. It was so near dark I suppose they could not see me, and at last they were within 20 or 30 feet of the ground. I shot and they flew away, but returned as soon as I began to imitate them again. At last they all departed for another woods."

The following additional notes on the same roost by Mr. Geo. S. Cottman appeared in the Indianapolis News (date not known):

CROW ROOST.

"About four and a half miles east of Indianapolis, and a mile and a half north of Irvington, a stretch of heavy woods was used by the crows for two winters (about '93 and '94).

"By four o'clock in the afternoon the crows begin to come in from every point of the compass; straggling at first, then in flocks that increase in number and size till continuous streams seem to be converging at this point, and the air overhead is fairly filled with a chaos of black flakes soaring and circling about. Evidently they come together for the purpose of enjoying a grand social carnival. They congregate in the adjoining meadows in vast crowds, where they walk about, intermingling and hob-nobbing; the rail fences present long, unbroken lines of black, and the isolated trees in the fields seem suddenly to have taken on some strange, large-leaved foliage. When this multitude take alarm and all rise at once, they are like the famous cloud of locusts, and it looks as if a rifle-ball fired at random would bring down a score. As one stands in the woods the spectacle of these thousands of birds swirling and eddying among the tree-tops has a bewildering effect, which is heightened by the incessant clamor. Free speech seems to be the order of the occasion. Every crow has something to say, and he says it, and as no individual can be heard for the others, the result is a conglomeration of noises that can be heard a mile, and which sounds precisely like a tremendous escape of steam. The jollification is continued till long after dark, and all through the evening they keep up a boisterous, many-voiced conversation. These mighty gatherings take place only through the winter, and during the summer lodgings in that locality are to let."

Mr. W. W. Pfrimmer informs me that there is a "rookery" near Newton and Demotte, in Porter County, where he thinks as many as 500 nests could be found on two or three acres. Mr. Nehrling describes their nesting in a colony in Texas.

In spring when mating-time comes the Crows scatter. They begin pairing in March. I have noted them most commonly between March 28 (1896), and April 9 (1881). Nests with full sets may usually be found between April 15 and May 1. In Lake County, Mr. L. T. Meyer has taken fresh eggs from April 8 to 15. Prof. Evermann found fresh eggs April 16 in Carroll County. They nest in all kinds of woodland, dense and open, river valleys and hill-land. Incubation lasts about eighteen days, and both parents engage in it.

The Crow is shy and cautious. They know that every man's hand is against them, and keep well out of reach of the man with a gun. A friend of mine says a Crow can count two, but his knowledge of mathematics ends there. Three persons may hide and after two have left the crow will return, but never till two have left.

The crow is charged with many crimes and is not given credit with many, if any, virtues. The United States Department of Agriculture has investigated the habits and foods of the Crow in the United States, and has issued a very valuable report thereon (Bulletin No. 6, Div. O. and M., U. S. Dept. Agr., by Walter B. Barrows and E. A. Schwarz). The Crow is found guilty of pulling up sprouting corn, eating corn, destroying chickens and their eggs, robbing the nests of small birds, destroying such harmless and beneficial animals as salamanders, toads, frogs and snakes and spreading the seeds of noxious plants. But it is found the facts are somewhat different from what they are popularly supposed to be.

The Crow only eats hard, dry corn when other food is not easily obtainable. It eats it readily when it is softened. Therefore, the softened, sprouting grains are desirable food. They also are fond of it when in the "roasting-ear," or milk stage. Mr. Lon Innis says they are very destructive to corn in this condition near Milroy, Rush County. The destruction of chickens and their eggs is much less than is commonly supposed; of the entire number of stomachs examined in the year (909), but 57 contained evidence of such food, which was a little over one-half of one per cent. of their total food. The same testimony is given as to the destruction of wild birds. Less, by far, are eaten than is commonly supposed. Only 50 stomachs, or about one per cent. of the whole number examined for the year, contained such food. Through the fall and winter season, especially, the seeds of many vines and trees are eaten. They are especially fond of poison ivy (*Rhus toxicodendron*), poison sumach (*Rhus venenata*), other sumac (*Rhus*), and also eat those of juniper or red cedar (*Juniperus virginianus*), flowering dogwood (*Cornus florida*), and sour gum (*Nyssa aquatica*). The seeds of such plants, together with sand, gravel, and other material eaten to assist in grinding the food, is ejected from the mouth usually in the form of pellets. They are thus spread over the country along fence rows, under shade trees, in orchards and other places to propagate undesirable plants. In September and October I have found the Crows feeding upon wild cherries (*Prunus serotina*), and beechnuts. Seeds of the former are doubtless distributed in the way just noted. Thus, as a whole, the injuries the Crow does are shown not to be so great as is generally supposed.

Most persons are disposed to note losses oftener and remember them longer than benefits. It is found to eat many insects. May beetles, June-bugs and noxious beetles, and quantities of them, are fed to their young. Grasshoppers are eaten all summer, but form the bulk of their food in August.

Besides these, many bugs, caterpillars, cutworms, and spiders, etc., are eaten. Of the insect food, Mr. E. A. Schwarz says: "The facts, on the whole, speak overwhelmingly in favor of the Crow." I have elsewhere (Bulletin 12, Div. of Ent., U. S. Dept. of Agr., 1886, p. 30) noted their eating 17-year cicadas (*Cicada septendecim*), and their eating all the tomato worms in a badly-infested tomato field, near Indianapolis (Trans. Ind. Hort. Soc., 1890, appendix c, p. 65). I am also informed of their coming in numbers into a timothy meadow which was practically destroyed by the larvæ of some insects and going over it thoroughly, tearing up the grass, roots and all, and destroying the insects. When they had finished the field was described as looking like a great flock of poultry had scratched it all over, but no insects could be found. In addition to the insects eaten, it was found that mice rank fourth in quantity in the items of animal food. For this, they must be given credit. It is thought in the more thickly-settled portions of the country that the crow does more good than harm, and if precautions are taken to protect the nests and young poultry and corn, its damage would not be of any considerable consequence.

XXXIX. FAMILY ICTERIDÆ. BLACKBIRDS, ORIOLES, ETC.

- a¹. Outlines of bill nearly or quite straight; the tip not evidently curved downward; the cutting edges not turned inward. Subfamily ICTERINÆ.
- b¹. Bill stout, conical, its depth at base equal to at least one-third its length; sexes unlike; female smaller.
 - c¹. Tail feathers sharp pointed; middle toe with claw longer than tarsus; bill shorter than head; finch like. DOLICHONYX. 110
 - c². Tail feathers not pointed at tips; middle toe with claw not longer than tarsus.
 - d¹. Bill much shorter than head; finch like. MOLOTHRUS. 111
 - d². Bill about as long as head.
 - e¹. Claws of side toes about half as long as middle claw, reaching little if any beyond base of middle claw. AGELAIUS. 113
 - e². Claws of side toes much more than half as long as middle claw, reaching much beyond base of middle claw. XANTHOCEPHALUS. 112
- b². Bill slender, its depth at base scarcely one-third its length.
 - f¹. Tail less than two-thirds length of wing, its feathers pointed; bill longer than head; sexes similar. STURNELLA. 114
 - f². Tail nearly as long as wing, its feathers not pointed; bill shorter than head; sexes not similar. ICTERUS. 115

a². Outlines of bill distinctly curved, the tip distinctly curved downward; cutting edges turned inward. Subfamily QUISCALINÆ.

g¹. Tail much shorter than wing, nearly even; bill slender, shorter than head. SCOECOPHAGUS. 116

g². Tail longer than wing, middle feathers much the longer; bill as long as or longer than head. QUISCALUS. 117

110. GENUS DOLICHONYX SWAINSON.

***187. (494). Dolichonyx oryzivorus (LINN.).**

Bobolink.

Synonyms, WHITE-WINGED BLACKBIRD, REEBIRD, RICEBIRD.

Adult Male in Spring.—Mostly black; nape, deep buff; back, streaked with buff; patch on side of breast, rump and scapulars, whitish; upper tail-coverts, light ash; outer primaries and tertials, margined with yellowish-white; bill, blackish horn; feet, brown; tail feathers pointed. *Female and Male in Fall and Winter.*—Above, yellowish, or yellowish-olive; crown and back, conspicuously streaked with black, nape and rump with smaller markings; crown, with a central stripe, and stripe over each eye olive-buff, or olive-gray; wings and tail, brownish, edged with lighter; tail feathers, sharp-pointed. Below, yellowish or whitish, shaded with buffy or olive; sides and lower tail-coverts, more or less distinctly streaked with black; bill, brown.

Length, 6.30-7.60; wing, 3.70-4.00; tail, 2.60-2.90.

RANGE.—America, from Paraguay north to Nova Scotia and Manitoba, west to Nevada, Utah and British Columbia. Breeds on coast of Louisiana and from southern New Jersey, southern Indiana and Kansas northward. Winters from West Indies southward.

Nest, on ground, frequently in natural depression, in bunch of grass in meadow, prairie, or dry marsh; of fine, dry grass, straw or weeds. *Eggs*, 4-5, and occasionally 6-7; gray, bluish-gray, bluish-white, spotted and veined with various shades of brown and gray, heaviest at large end; .81 by .61.

The Bobolink is a regular migrant in southern Indiana, but is rare. It is a common summer resident in the northern part of the State, and in some localities breeds abundantly. At the time of the settlement of the country by white men it was probably found in summer about the lower end of Lake Michigan, extending westward some distance into Illinois and south into the prairies of the Kankakee basin and as far east as Rochester in Indiana, thence northward to, and, possibly, into southwestern Michigan. It is probable some were to be

met with about the western end of Lake Erie, extending a short distance into that State. From the first, or both of these centers, they have extended their summer range until it has spread over the State from east to west in its northern part, and reached points as far south as northern Union County and the counties of Wayne, Delaware,



Bobolink.

(Beal.—Farmers' Bulletin 54, United States Department of Agriculture, p. 18.)

Madison, Marion, Clinton, Tippecanoe and Vigo, in all of which it breeds. However, it is not generally distributed and usually occurs locally. It is a rare summer resident and probably breeds in Decatur County, where Prof. W. P. Shannon found a pair July 2, 1896. In Carroll County, Elkhart County, and perhaps other counties, it is found rarely, if at all, and in others in but few localities. However, there are places where it is found abundantly. It has been observed in a number of these counties, as well as several others for the first time within the last few years. Doubtless it will continue to extend its range, and we watch its movements with much interest. They evidently reach their breeding grounds by migrating, farther eastward, doubtless along the Atlantic coast, and then turning west towards the lower end of Lake Michigan. They often are found in the area they

originally occupied as early or earlier than they are further southward, where they are only rare migrants. And the small numbers that pass in the spring cannot be compared to the multitudes found breeding northward. In the southern portion of the State, the following will give the earliest and latest dates in a series of years when the first Bobolink was seen in spring: Bicknell, April 28, 1896; May 3, 1894 and 1897; Bloomington, April 17, 1885, May 6, 1882 and 1888; Brookville, April 6, 1890 (the earliest record for the State), and May 5, 1881; Moore's Hill, April 23, 1893, April 27, 1888; Greensburg, April 26, 1896, May 8, 1895; Terre Haute, May 3, 1890, May 13, 1889. In the southern part of northern Indiana they appear a little later, from May 2 to 11.

At Muncie they were first seen May 6, 1893, and May 11, 1890; Lafayette, May 5, 1890; May 7, 1892; Red Key, May 2, 1895; North Manchester, May 3, 1896. Farther north, where they breed commonly, they are usually first seen between April 26 and May 5, most always by May 9; Lake County, April 27, 1887; May 8, 1889; Dekalb County, April 27, 1896; May 9, 1889; Laporte, April 27, 1894; Wayne County, Mich., April 26, 1896; April 27, 1892, and 1893; Petersburg, Mich., April 28, 1891, May 2, 1886, 1889, 1892 and 1893.

The males usually precede the females by from two days to two weeks. The crowning glory of prairie life in the spring is the lively antics, the ardent courtships and, above all, the beautiful music of the Bobolink, whether on the ground, in a treetop or in midair, his sweet song comes to us with the perfume of early clover blossoms. These remain twin impressions, indelibly impressed upon one's mind. The wife builds her nest of straws, grasses and weeds, on the ground, usually in a depression, but sometimes in a tuft of grass, and there assumes the duties of incubation and the care of a family. The husband is the stylish and attractive member of the family. "She broods in the grass while her husband sings." The female Bobolink in spring, and both sexes and young in fall, are a puzzle to young students of birds. The male he can readily determine, but the sparrow-like dress of the female in the spring, and of both adults and young in the fall, cause him much perplexity. Fresh eggs are usually to be found from May 20 to June 5. Between June 15 and July 5, the nests usually contain young. The males keep up their singing until the beginning of July, and then suddenly stop, change their dress to that of the female and become songless. Only a metallic click is then uttered. I have found them in full song at Eagle Lake as late as July 4. It is generally thought they leave about July 20. While a few may start upon their return journey then, the greater number seek good feed-

ing grounds and remain until the middle of August. Some, comparatively few, remain later than this. In 1894 the last was reported from Plymouth, Mich., September 12; Cook County, Ill., September 21. In 1890 I received one from Mr. H. N. McCoy, which he killed at Marion, Ind., September 29. Prof. E. L. Moseley reports about 150 at Sandusky, O., September 4, 1897. However, they flock to the Atlantic Coast in great numbers towards the middle of August and descend in immense swarms upon the rice fields of the South Atlantic and Gulf States. Apparently they journey southward, following the coast line, and some distance out. There they appear to arrive from seaward, "punctually on the night of the 21st of August" (U. S. Agr. Rept., 1886, p. 249). They at once proceed to destroy all the rice on which the grain is in the milk, as well as untold quantities of ripening grain. The annual loss to rice growers in this country on account of Bobolinks is estimated at \$2,000,000. For, not only do they consume so much in the fall, but in April and May, as they come north, they stop to lay in waste the fields of young grain. The Bobolink, with us, is an entirely different bird, given to sweet songs, odd actions and good deeds. With us, it lives upon insects and seeds that are of no especial value. During the time the young have to be provided for they are fed mostly insects. The meadows, marshes, pastures and prairies are its home, and multitudes of insects which infest such places are eaten each year. (See The Bobolink in Indiana Proc., I. A. S., 1896.)

111. GENUS *MOLOTHRUS* SWAINSON.***188.** (495). ***Molothrus ater*** (BODD.).**Cowbird.**

Synonyms, COW BUNTING, BLACKBIRD.

Adult Male.—Plumage, mostly lustrous black, with purple and green reflections; head and neck, brown. *Female*.—Smaller; brownish-gray, darker above; chin and throat paler, apparently streaked, owing to the darker lines along the shafts of most of the feathers. *Immature*.—Similar to female, but more buffy; bill and feet, black.

Male, length, 7.75-8.25; wing, 4.00-4.60; tail, 2.90-3.35. Female, length, 7.00-7.50; wing, about 3.75; tail, 2.75.

RANGE.—North America, from southern Mexico north to New Brunswick and Athabasca (Little Slave Lake). Breeds from Georgia, Louisiana and Texas, northward. Winters from southern Illinois and southern Indiana, southward.

No nest. Lays in the nests of other birds; number of eggs unknown. *Eggs*, white, speckled and blotched with dark and light brown; .84 by .65.

Abundant summer resident. Favorable winters, some remain in the southern part of the State. Mr. E. J. Chansler found it remained in some numbers at Bicknell, the winter of 1896-7. I found it as far north as Brookville, November 24, 1887. They begin to return some years very early. In 1882 I noted it at Brookville, February 28, while



Cowbird, reduced.

in 1883 I did not see one until April 4. Mr. V. H. Barnett noted it at Spearsville, February 28, 1895, and March 6, 1894. The following are earliest and latest dates of first arrival for places named: Greensburg, March 23, 1895, March 28, 1896; Sedan, March 6, 1889, April 17, 1894; Laporte, March 30, 1886, April 10, 1894; Lake County, March 13, 1886; Petersburg, Mich., March 17, 1889, March 18, 1897. The females arrive later in the spring than the males. They begin mating some years late in March, and continue well through April. At Brookville, I have seen this beginning March 25, 1884. When they arrive late in March, or after, they are mated.

The Cowbird is polygamous. The dark male may be seen with several lighter females. The attentions to them are very persistent. With many motions, he puffs himself up, erects his feathers, droops his wings and spreads his tail, conscious of his own importance. All this ends in a farcical attempt to sing. Its ordinary call, Mr. Nehrling well says, is a shrill "cluck-see"; while it has, also, a shrill one-syllable screech.

The Cowbird builds no nest. It is a parasite. As the European Cuckoo, and to a limited extent our American species, lays eggs in the nests of other birds for them to hatch and rear, so does this bird.

Most persons have seen it accompanying the cattle in pasture. Mr. Widmann thinks, thus, it used to accompany the American Bison. In its migrations, and because of its wanderings, it could neither build a nest or take time to rear a family. Thus, to his mind, was the habit formed. No one kind of bird is selected to be the foster parent. Major Bendire mentions ninety species of birds in whose nests Cowbirds' eggs have been found. These range from the size of the Mourning Dove, and Meadow Lark, to the little Blue-gray Gnatcatcher and House Wren. Such well known birds as the Phoebe, Song Sparrow, Tewhee, Indigo Bunting, Oven-birds, and Yellow-breasted Chat, are most often imposed upon. The Yellow Warbler, however, is often a match for the Cowbird; frequently she buries the latter's egg or eggs and her own beneath a second story built on top of her nest, and deposits another set of eggs. Mr. E. R. Quick, of Brookville, has a nest of this Warbler to which a third story has been added, burying two efforts of the Cowbird to perpetuate its kind. There have been other such nests found. The Acadian Flycatcher and, perhaps, Traill's Flycatcher, disposes of the Cowbird's eggs in the same way, sometimes.

"It is very interesting to observe the female Cowbird ready to lay. She becomes disquieted. At length she separates from the flock and sallies forth to reconnoitre, anxiously, indeed, for her case is urgent and she has no home. How obtrusive is the sad analogy! She flies to some thicket, or hedgerow, or other common resort of birds, where, something teaches her, perhaps experience, nests will be found. Stealthily and in perfect silence she flits along, peering into the depths of the foliage. She espies a nest, but the owner's head peeps over the brim, and she must pass on. Now, however, comes her chance; there is the very nest she wishes, and no one at home. She disappears for a few minutes, and it is almost another bird that comes out of the bush. Her business done, and troubles over, she chuckles her self-gratulation, rustles her plumage to adjust it trimly and fly back to her associates. They know what has happened, but are discreet enough to say nothing; charity is often no less wise than kind" (Dr. Coues, *Birds of the N. W.*, p. 185). The Cowbird's egg is said to hatch in about ten or eleven days. It hatches earlier, the young is larger, more persistent, or has some quality that is usually not found in the nest-mates. So it thrives and the others perish. Every Cowbird's egg is usually the cause of the destruction of a whole brood of more useful birds. They disappear as the dryer summer months come on, seeking the swamps and marshy pastures. In September they migrate, a few, however, remaining through the succeeding months and well into November. Most years they are gone before October 1. In Lake County they

sometimes remain until October. The following are some other records: Sedan, October 29, 1889; Sandusky, O., October 17, 1896; Cook County, Ill., October 5, 1895; Greensburg, October 31, 1896, November 16, 1894; Plymouth, Mich., October 24, 1894; Hillsdale, Mich., November 1, 1894.

112. GENUS XANTHOCEPHALUS SWAINSON.

*189. (497). **Xanthocephalus xanthocephalus** (BONAP.).

Yellow-headed Blackbird.

Adult Male.—Head (except lores), neck and chest, yellow; primary coverts and some of greater coverts, white; rest of plumage, black. *Female and Immature*.—Brownish-black; little or no white on wing; yellow, restricted or obscured. Female smaller than the male.

Male, length, 10.60-11.10; wing, 5.65-5.80; tail, 4.50-4.85. Female, length, 9.00-10.00; wing, 4.40-4.65; tail, 3.50-3.70.

RANGE.—Western North America, from Mexico (Valley of Mexico), north to British Columbia, and Keewatin; east to Manitoba, Wisconsin, Indiana, Missouri and Texas. Breeds throughout its range. Winters from Louisiana and Texas, southward.

Nests, in colonies; nests fastened in rushes or other aquatic plants, of grass, reeds and rushes, lined with finer grass. *Eggs*, 2-5; grayish or greenish-white, rather evenly blotched or spotted with different shades of brown, drab and pearl-gray; 1.02 by .71.

This Western species is a summer resident in some localities, in northwestern Indiana. It frequents swamps and has a preference for certain localities, where it breeds in colonies. Mr. C. E. Aiken informs me that he found it breeding abundantly along the Calumet River, in Lake County, in 1871. He took over a hundred eggs. Mr. Geo. L. Toppan has also found it breeding in Lake County, and also abundantly about Mud Lake, over the line, in Illinois. There is a pair in the State Museum that are marked from Porter County. Mr. Ruthven Deane informs me one was taken from a flock of Red-winged Blackbirds at English Lake, August 7, 1897, and Mr. Chas. Dury says he obtained specimens from there years ago. None, however, have been reported from there for fifteen years or more. The habits of the Yellow-headed Blackbird are, in many respects, similar to those of the Red-winged Blackbird. They are swamp birds. The nest is built in reeds or tufts of grass; they have the somewhat similar harsh clacking notes.

They feed upon seeds of swamp plants; sometimes do damage to green corn before the ears glaze, but eat large numbers of insects. An egg is laid daily, and but one brood reared a year. Incubation lasts about 14 days. They arrive in May and depart in August or September.

113. GENUS AGELAIUS VIEILLLOT.

*190. (498). *Agelaius phœniceus* (LINN.).**Red-winged Blackbird.**

Synonym, SWAMP BLACKBIRD.

Adult Male.—Plumage, deep black; lesser wing coverts, bright red, bordered behind with broad band of brownish-yellow, buffy or white. In fall or winter, black, more or less edged with brown. *Adult Female*.—Smaller; above, blackish, with brown and white streaks; light stripe over eye, and inconspicuous light stripe along center of head; lesser wing coverts, with more or less red; wings, barred and edged with white or brownish; below, streaked with black and white; throat, tinged with pink or yellow. *Immature*.—Like female, but browner above and more buffy below.

Male.—Length, 9.00-10.00; wing, 4.60-5.05; tail, 3.55-3.95. *Female*.—Length, 7.50-8.50; wing, 3.80-4.25; tail, 3.10-3.40.

RANGE.—North America, from Costa Rica north to New Brunswick and Mackenzie River Valley (Ft. Simpson). Breeds from coast of Gulf States, north. Winters from Virginia and southern Indiana, southward.

Nest, and site, similar to that of last mentioned species. *Eggs*, 2-6; pale bluish-green, spotted and irregularly streaked with black and various shades of brown, drab and purple; .98 by .69.

An abundant summer resident about swamps and the reedy borders of lakes, and streams; elsewhere, rare, or only seen during the migrations. Some winters, remain in the southern part of the State. The winter of 1884-5 one was taken in January at Paris, Ill., and a few were seen, at odd times during February, at Odin, Ill. (Cooke, Rept. B. Mig. in Miss. Valley, p. 164). January 14, 1895, Mr. V. H. Barnett found four at Spearsville, and the following winter it remained at Bicknell as late as December 1. The winter of 1896-7 they also remained there in some numbers (Chansler).

To note the movements of the Red-winged Blackbird one should be near its summer home. They proceed directly to such places, and, though a few often precede the main body, they are often found there

in force before any of the chance migrants are seen farther south. At Brookville it is only seen occasionally, as it passes over or stops beside the river, perhaps, some days, after it has appeared about the northern swamps. In the Whitewater Valley and, in fact, throughout southern Indiana, generally, there are few localities favorable to it; so that a



Red-winged Blackbird.

(Beal.—Farmer's Bulletin 54, United States Department of Agriculture, p. 20.)

fish pond containing a few cat-tails, a sedgy shallow in the old canal bed, or a bit of wet land, the remnants of an old marsh or beaver pond. afford about the only nesting sites. In the northern part of the State. where the marshes and marshy lakes are found, they are found in flocks numbering thousands.

They may be observed, on first arrival, in the southern part of the State, some time from January to March; and among the northern marshes, from February 17 to March 28. The following dates are the earliest and latest it was first seen at the points named: Brookville, February 21, 1888 and 1892, March 25, 1897; Frankfort, February 28, 1896, April 6, 1893; Dekalb County, February 17, 1897. February 22, 1886 and 1888; Lake County, March 11, 1893; Cook County, Ill., March 20, 1886, March 28, 1885; Carroll County, February 12 (Evermann). Its call is one of the characteristic sounds of the marshes. Emerson says it calls "*o-ka-lee*." Nehrling gives

this call: "*con-cur-ee*," and says its whistling noise is *tii-tii*. Generally they nest in colonies. The males are polygamous. Each one has usually two females. But this is not always so. For, often in these latter days, when draining and ditching are driving many birds to other haunts, and habits, solitary pairs are found about many little cattle ponds, fish ponds, or springy drains. They are even becoming noticeable in the more level country. In many meadows, where is a wet place, no water, a nest or two will be found. Prof. W. P. Shannon calls my attention to the fact that they are frequenting such places in Decatur County, and thus becoming more generally distributed and better known than they formerly were. The spring of 1897 he found two nests about such a place, one in a bunch of *sour-dock*, the other in a tuft of white top. Nests are found the middle of April, and full sets of fresh eggs are found until, at least, near the middle of May—Waterloo, May 12, 1885 (Snyder). Their nests and those of the last mentioned species are similar in construction and location, as a rule. The Red-winged Blackbird sometimes builds in bushes or trees, as much as fifteen feet from the ground. Mr. J. O. Snyder told me of one nest he found that was 18 inches in diameter. They usually rear but one brood in a season. One egg is laid daily, and it requires about two weeks for them to hatch. In August and September they collect in flocks in the upper Mississippi Valley, where they breed much more abundantly than they do with us. At this season they do much damage to the maturing corn. In the South, among the rice fields of the Gulf coast, they do great damage. Prof. Beal's investigations show that, of 725 birds examined, 74 per cent. of their food was vegetable matter and 26 per cent. animal. Insects were the greater part of the latter, and consisted chiefly of beetles, weevils and grasshoppers. The quantity of grain eaten was less than we would have supposed. It constituted but a little over 13 per cent. of the total food, and consisted of corn, wheat and oats; oats form nearly half of that amount.

The principal food, in fact, almost the entire food, in winter, was weed seed. That formed 54 per cent. of the year's food. Thus noxious and injurious insects form its principal food, and, save in certain localities, it is decidedly a beneficial bird.

They wander about through the fall, sometimes starting southward in September. Other years they are passing through October and even remain northward some winters until early November (J. G. Parker, Jr.). The following are a few dates showing range at which last specimens were seen: Lafayette, Ind., October 5, 1895; Bicknell, September 28, 1894, December 1, 1896; Brookville, November 11, 1886.

114. GENUS STURNELLA VIEILLLOT.

*191. (501). *Sturnella magna* (LINN.).

Meadow Lark.

Adult.—Above, prevailing color black, crown with buff middle stripe; yellow and buff stripe over eye, black stripe from eye back; cheeks, ashy; back, streaked with brown, and buffy; outer tail feathers, white, middle ones pointed; they with the inner quills and wing coverts, barred or scalloped with black and brown, or gray; edge of wing and spot in front of eye, bright yellow; below, yellow, a black crescent on breast; sides and crissum, whitish, with black spots.

Male.—Length, 9.50-11.00; wing, 4.40-5.00. *Female*.—Length, 8.00-10.00; wing, 3.95-4.30.

RANGE.—Eastern North America, from Gulf of Mexico north to Nova Scotia and Manitoba; west to Great Plains. Winters from Kansas, Indiana and Massachusetts, southward. Breeds throughout its range.

Nest, in meadow, in depression in ground, of grass and weeds, arched over and protected by growing grass. *Eggs*, 3-7; white, spotted and blotched with brown or purple; 1.09 by .89.

Abundant summer resident. Resident in the southern portion of the State. Some severe winters it mostly or entirely leaves. Other winters it is found throughout the State. It has been reported in winter from Brookville, where it remains during mild winters; Wabash County, often (Ulrey and Wallace); Carroll County, occasionally a few (Evermann); Brown, often (Barnett); Zanesville, Wells County, remained, 1896-7 (Hamilton); Petersburg, Mich., a few remained, 1896-7 (Trombley). In the northern part of the State the migration begins: In Dekalb County, as early as February 12, 1891, and as late as March 17, 1886; in Cook County, Ill., March 20, 1888, March 28, 1885. In the southern part of the State, most years, the migrations begin in February, and frequently they are common by February 20. I have known them in full song March 8 (1893).

But mating does not usually begin until early April; sometimes, however, it is observed in March. Sometimes the bird scoops out a hole in the side of a tussock of grass and builds its nest, arching it over with the grass above. Usually it is placed in a little depression in the ground. It is made of such materials as are at hand—grasses of varying coarseness—and a lining of finer growth. The male sings while the female works. Prof. W. P. Shannon found a nest, with three eggs, near Greensburg, April 25, 1896, while I have taken the

first laying, at Brookville, May 28, 1892. Mr. E. R. Quick took a set of fresh eggs near the same place, July 15, 1879. This was a second laying in a nest in which young had been hatched a few weeks before. The nest was relined before the second laying. Mr. J. O. Snyder took a set of eggs, possibly also a second set, at Waterloo, July 17, 1885. An egg is deposited daily, and incubation takes about fifteen days. Both sexes assist in the latter.



Meadow Lark.

(Beal.—Year Book, United States Department of Agriculture, 1886, p. 421.)

The song is variously interpreted. Mr. Ridgway says country people sometimes interpret it as "Laziness will kill you," or "Peek-you-can't-see-me;" the accent on the next to the last syllable. Mr. Nehrling says it sounds like "He-ah-he-here," or "et-see-dee-ah." After the harvest is over and the young are able to care for themselves, most of the Meadow Larks seek choice spots, and but seldom are their songs heard. However, when the fall rains come, and start the grass, they regain their voices. I found them in restless flocks during the dry weather, September 30, 1897, and in full song. At times they sing quite late. November 11, 1886, a sunny, pleasant day, I found them abundant and in full song at Lawrenceburg Junction.

The Meadow Lark is one of our most beneficial birds; and, as it should be, has a good reputation. Every one speaks well of it. In 238 stomachs examined by the Department of Agriculture, animal food, practically all insects, constituted 73 per cent. of the contents; and vegetable matter, 27 per cent.

The insects were ground species, such as beetles, bugs, grasshoppers and caterpillars, some flies, some wasps, and spiders. Crickets and grasshoppers constitute 29 per cent. of the entire year's food, great numbers being eaten in August, when these insects are most numerous. Beetles come next, being nearly 21 per cent. They may become very valuable in combating new enemies of the meadow, such as the rapidly spreading *clover root borer*, and *clover leaf weevil*. The vegetable food is grain, weed and other seeds. Grain amounts to 14 per cent., and, being eaten in winter and spring, is probably principally waste grains. Only six birds had eaten clover seeds (See also Beal, Year Book of U. S. Dept. of Agr. for 1895, p. 419, et seq., and Farmers' Bulletin No. 54, same Dept., May, 1897, p. 21).

It will thus be seen that the Meadow Lark is almost entirely beneficial. Care should be taken to protect it, not only from the shooter, who wants something to practice upon, but also from unnecessary destruction in any form. The mower, particularly in meadows of red clover, when first cut, destroys many nests, eggs and young.

115 GENUS ICTERUS BRISSON.

a¹. Tail graduated, its length about equal to wing; bill slender, curved downward at tip; adult male, chestnut and black. Subgenus *PENDULINUS* Vieillot.

I. *spurius* (Linn.). 192

a². Tail nearly even, much shorter than wing; bill not curved downward; male, orange and black; female, duller. Subgenus *YPHANTES* Vieillot.

I. *galbula* (Linn.). 193

Subgenus *PENDULINUS* Vieillot.

***192. (506). *Icterus spurius* (LINN.).**

Orchard Oriole.

Adult Male.—Black; lower back, rump, lesser wing coverts, and all under parts from throat, deep chestnut; a whitish bar across the tips of the greater wing coverts; bill and feet, blue-black; tail, graduated. *Adult Female*.—Smaller; above, grayish olive-green; wings, dusky; tips of the coverts, and edges of the inner quills, whitish; below, yellowish. *Young, first year*: Similar to female, but browner above. *Young, second year*: Similar to last, but with black mask, and sometimes showing patches of chestnut.

Length, 6.00-7.25; wing, 2.90-3.25; tail, 2.65-3.20.

RANGE.—America, from Colombia over eastern United States to Massachusetts, Ontario, Michigan and North Dakota, casually to New Brunswick. Breeds from Gulf of Mexico and Rio Grande, north. Winters south of United States.

Nest, of green grass, lined with plant down; in tree, in orchard, lawn or grove. *Eggs*, 4-6; pale bluish-white, blotched, spotted and veined with brown, purple, lavender and pearl gray; .81 by .57.

The Orchard Oriole is a summer resident. In most counties in the State it is common, being more numerous where there are extensive orchards and attractive lawns. It is generally shown that these birds are steadily increasing in numbers. In the extreme northern part of the State they are extending their range, as well as increasing numerically. Prior to 1883, they are reported to have been unknown in portions of Dekalb County, and it was very rare in portions of Lake County. The orchard is its home, and not the deep woods. As conditions become more inviting, they will increase. While a few years ago the Baltimore Oriole was much more abundant than this, an estimate I made the present spring (1897) shows that these birds outnumbered the last mentioned species ten or fifteen to one.

The Orchard Oriole comes in spring, with the blooming of the Buckeye, and it frequents thickets, at first, where that bush or tree is found.

The earliest records are from Bicknell and Brookville. April 18, 1896, it appeared at each place. The following are the dates it first arrived in the places named in the spring of 1897, an early spring, and where second date is given, it is the latest date of first arrival: Brookville, April 24, 1897, May 14, 1888; Bicknell, April 22, 1897, April 27, 1894; Richmond, April 26, 1897; Lafayette, April 26, 1897; Sandusky, O., May 9, 1897; Petersburg, Mich., May 6, 1897, May 8, 1889. The dates next given are earliest and latest dates of first spring arrival: Dekalb County, April 19, 1896, May 20, 1888; Cook County, Ill., May 9, 1896, May 15, 1884. The females arrive after the males from several days to near two weeks.

In southern Indiana most years the Baltimore Oriole arrives first. At Brookville, but twice in fifteen years' observations do I find this species noted as occurring in advance of it, while in 1893 it was just two weeks later in arriving.

I have observed it mating as early as April 27, 1881, and May 4, 1886. In southern Indiana sometimes the full complement of eggs is laid about the middle of May. Prof. W. P. Shannon found the parents feeding their young May 31, 1896. Usually, however, they are about two weeks later. In the northern part of the State they breed in June. A set of fresh eggs was found at Waterloo, June 3, 1885 (Snyder); and an incomplete set at Lafayette, June 10, 1897 (Test).

The nest is usually placed in an orchard tree, most often an apple tree. It is made of green grass blades, and is placed in the crotch or

fork of a limb. The color of the nest renders it inconspicuous. One egg is laid daily. Incubation lasts about twelve days, and it was Major Bendire's opinion that this was performed exclusively by the female. One brood only seems to be raised each year.

During the spring and early summer, the old birds have lived upon the insects in the orchard. Next, upon such food they feed their ever-hungry young, and when they leave the nest the whole family goes into the cornfield to feast upon the insect enemies of the corn.

No bird deserves better treatment by the orchard man and farmer. Except a few berries and fruit blossoms, almost their entire food seems to be injurious insects. These include green worms, hairless caterpillars, beetles, flies, cabbage worms and plant lice.

They are very destructive to insects that feed upon the foliage of trees, berries, bushes and grape-vines; among the latter they use their sharp bills to destroy the cocoons wrapped within the leaves.

It has a loud, rattling call, which Mr. Nehrling expresses by "tarrrrrrr," besides a sprightly song, often partly sung on the wing. The song grows less frequent in late June, and seldom is heard in the Whitewater Valley after early July—July 9, 1886.

They leave early and almost unnoticed. Often but few are to be found early in August. The last of the year was reported from Sedan, August 24, 1892; Plymouth, Mich., August 18, 1894; Bicknell, August 30, 1895, and July 27, 1896; Vermillion County, August 28, 1897.

Subgenus *YPHANTES* Vieillot.

***193. (507). *Icterus galbula* (LINN.).**

Baltimore Oriole.

Male.—Head and neck all around, and back, black; rump, upper tail coverts, lesser wing coverts, most of the tail feathers and all the under parts from the throat, fiery orange, but of varying intensity, according to age and season; middle tail feathers, black; the middle and greater coverts and inner quills, more or less edged and tipped with white, but the white on the coverts not forming a continuous patch; bill and feet, blue-black. *Female*.—Smaller, paler; the black obscured by olive, or sometimes entirely wanting. *Young*.—Similar to female, but wanting black on throat and head.

Length, 7.00-8.15; wing, 3.50-3.90; tail, 2.85-3.35.

RANGE.—America, from Colombia to Nova Scotia and Saskatchewan; west to Rocky Mountains; casual to Hudson Bay and Keewatin; accidental in Cuba and Shetland Islands. Breeds from Gulf of Mexico, northward. Winters south of United States.

**Nest*, pensile, purse-shaped, suspended from slender branch of tree; of vegetable fibres, hair, string and shreds of bark. *Eggs*, 4-6; pale grayish-white, blotched, spotted and irregularly lined with black, brown and lavender; .91 by .61.

Summer resident. Frequents the vicinity of water. The trees along water courses and about ponds and lakes are favorite places both for feeding and nesting. In many localities away from streams, this



Baltimore Oriole.

(Beal.—Year Book, United States Department of Agriculture, 1895, p. 427.)

Oriole is rare. Sometimes during the spring migrations they are generally distributed over the country. They apparently have been much less common the past few years. Their winter home is eastern Mexico, Central America, into the United States of Colombia. Cuba is the only one of the West Indies visited. One noting their restricted winter home, and seeing the large proportion of the skins of these birds shipped from there for purposes of decoration and adornment, need have no difficulty in understanding how that may have a considerable effect upon the number that returns to us in the spring.

But the spring of 1897 they were more numerous during the migrations for a few days than I ever saw them. They were found wherever trees grew. In the deepest woods and orchards; on hilltop and valley; in country and town. In one small apple tree, May 6, I found

three busy, insect catching, and for the next two or three days they continued from one to four in almost every tree. I never knew so many birds of all species among the orchards as there were last spring. They seemed busy all the time, and there must have been much insect food and a great destruction of such forms. As it was, there was an unusual abundance of insects left to damage the fruit. But little late fruit, or fruit trees, escaped unharmed. What would have been the destruction had not this innumerable army of insect-eating birds thoroughly inspected and cleansed our trees from the earlier destroyers?

They cross our southern border usually between April 15 and 25. One advance straggler was reported from Ellsworth, Vigo County, April 10, 1897. It was next seen April 16. The year 1889 there were some of these birds that moved quite early. The first was reported from Terre Haute, April 17; Oxford, O., April 18; Waterloo, April 18; Petersburg, Mich., April 19. The bulk of the birds were detained, however, and they were not common until after they often are in other years; 1888 was about an average of their first arrival. The following are the dates reported: Brookville, April 22; Terre Haute, April 24; Clinton County, April 25; Burlington and Waterloo, each, April 26; Rochester, April 27; Cedar Lake, Lake County, April 28. A single specimen was reported from Ann Arbor, Mich., April 25, but it was not noted at Bay City, Mich., until May 5. As with many other species, its movements begin to be slower as it approaches the lower end of Lake Michigan. The earliest and latest date of first arrival at Chicago, is April 27 and May 8, 1897. On the eastern side of Michigan and Indiana, it arrives sooner. The earliest and latest date of arrival at Petersburg, Mich., April 19 (1889), April 27 (1897).

Prof. B. W. Evermann noted it at Bloomington the four years ending 1887, as first arriving on April 20, 21, 20, 21, respectively. I have never found it so regular at Brookville. The following dates of first arrivals there for a series of years are of interest: 1881, April 25; 1882, May 3; 1883, April 26; 1884, April 27; 1885, April 23; 1886, April 25; 1887, April 23; 1888, April 25; 1889, April 20; 1892, April 29; 1893, April 17; 1894, April 28; 1895, April 26; 1896, April 18; 1897, April 20.

It usually becomes common, then, April 28-30, though in 1896 it was common April 20. The males appear first, and the females arrive about the time the species becomes common. With us, they, and the Orchard Oriole, arrive close together, but by the time they reach Michigan the last named form is behind. When they first arrive, the males have a lively, attractive song. Nuttall gives it as "tshippe-

tshayia-too-too, tshippe-tshippe-too-too." I have observed them mating as early as May 3 with us, and have found the nest completed May 30, and young June 1. Mr. L. T. Meyer has reported young in Lake County May 30, and Mrs. J. L. Hine fresh eggs from Sedan June 1. The nest is the finest bird structure found with us. It is a pensile, purse-shaped composition, into which strings, fibres, tow, hair and various other pliable materials enter. Maj. Bendire says it requires from five to eight days to build the nest. One egg is laid daily, and one brood reared each season. Incubation lasts about fourteen days, and it is said the female performs most of that duty. It is said the young are fed upon insects. This is partly true. The past season a pair of these birds built their nest in a fir tree in my yard, on a limb reaching over an alley. I observed the old birds, when the young were hatched, catching what seemed to be insects for them. They were also frequent visitors to my strawberry beds, eating and carrying away what they wanted. This was kept up until late in June.

June 25 my boys found that one of the young was fastened in the nest. I cut off the limb and found one leg entangled in the strings. It had been there some time, as the muscles were shriveled and the leg useless. The bird was lively and voracious. From the stains on its feathers, and the droppings in the nest, it was plain to be seen that a large part of its food for some time had been strawberries.

The attractive song of first appearance gives place to a shorter one about June 1. "Who-ee, here-we-are," or "who-ee-who-ee-who-ee-who" it seems to say. As the days pass by, this is shortened by two or three syllables. The last syllable is always short and emphatic. The staccato effect is very characteristic. The rattling call, "kur-r-r-t," still continues, as when it first came. Through June the songs get less frequent. The last I heard—a fragment—was June 25, this year. July 24, I again heard its song. The performance was like that of mid-June, but finer. This was continued into the early part of August. August 9, I heard one singing little parts of songs, and the last I heard of these attractive birds was a "kur-r-r-t," August 12.

They begin to leave late in June, and through July and August but few remain with us. Some years none are seen after the middle of August. Others, they remain well into September, and Prof. W. P. Shannon reported one from Greensburg, October 1, 1896. That is the latest record for the State. In 113 stomachs examined, caterpillars constituted 34 per cent. of the food. The other insects found were beetles, chiefly clickbeetles, the larvæ of which are very destructive, bugs, ants, wasps, grasshoppers and some spiders. Vegetable material was found to be a little over 16 per cent. of the food

eaten. They eat a few peas, blackberries and cherries, as shown by the returns. On the whole, they are exceedingly beneficial.

Good looks and good deeds with them go together (see article by Prof. F. E. L. Beal, in Year Book U. S. Dept. of Agr. for 1895). The Baltimore Oriole has been accused of damaging grapes, but examination of the stomachs did not seem to sustain the charge. Mr. Isham Sedgwick, of Richmond, Ind., informs me that for three succeeding years, 1894-5 and 6, these birds damaged his grapes. Both he and other members of his family saw the birds at work, and agree that they neither ate the fruit nor sucked the juice of the grapes they pecked. The bird would bite every grape in a bunch in 15 to 20 seconds. One year they wholly or partially destroyed about 75 bunches of fruit. Mr. Sedgwick once, while watching for the bird, saw it come and chase and capture several bees, which were about grapes where the skin had been broken. I suspect that is the clue that will reward the inquirer with the cause of the Oriole nipping the grapes. Insects are attracted by the grape juice in punctured fruit. The bird punctures the grapes to draw more insects that it may obtain food more easily.

116. GENUS *SCOLECOPHAGUS* SWAINSON.

194. (509). *Scolecophagus carolinus*. (MÜLL.).

Rusty Blackbird.

Adult Male in Summer.—Lustrous black, the reflections greenish.

Adult Male in Fall and Winter.—Similar, but with nearly all the feathers skirted with warm brown above and brownish-yellow below, frequently continuous on the fore parts. *Female and Young Male*.—Entirely rusty-brown above; the inner quills edged with same; a pale stripe over the eye; below, mixed rusty and grayish-black; the primaries and tail above, black; tail feathers of about equal length; bill and feet, black.

Length, 8.20-9.75; wing, 4.25-4.75; tail, 3.65-4.20.

RANGE.—North America, chiefly east of Rocky Mountains, from Gulf Coast to Labrador, Keewatin and Alaska; accidental in Lower California and Greenland. Breeds from northern New England, northern New York and Manitoba, northward. Winters from Indiana and Virginia, southward.

Nest, in saplings and bushes near wet places; of twigs, grass and moss; on a base of earth, lined with grass. *Eggs*, 4-5; light bluish-green, blotched and spotted with different shades of brown and gray; .98 by .72.

Migrant, most places rarely identified, but really common. Rarely, they may be found in winter in southern Indiana and Illinois, as far north as Catlin, Ill., and Knox County, Ind. Most of them pass farther south in early winter, remaining with us throughout the State, some years, until late in November.

Mrs. J. L. Hine reports them from Sedan, November 11, 1889; November 25, 1891; Mr. J. G. Parker, Jr., from Calumet, Ill., November 4, 1887; Greencastle, November 15, 1893. One taken to be this species was noted at Brookville, January 23, 1887; Brookville, November 17, 1885, November 24, 1887. Mr. A. W. Hamilton reports a number at Zanesville, Wells County, December 7, 1896. The greater number begin to return early in March, and may be seen in flocks in southern Indiana until past the middle of the month—March 21, 1883. The first arrivals pass on at once to the swampy portions of the State. There they may be found, some years, well through April. Mrs. Hine reports them from Sedan, April 28, 1892, and Mr. C. A. Tallman noted them in Cook County, Ill., May 1, 1897. In the fall they begin to return from their northern breeding grounds, some years by early October. Mr. Chansler noted it at Bicknell, October 5, 1894. Most of them remain about our smaller lakes through October, and in southern Indiana we generally see them in flocks in November. Major Bendire says the ordinary call note is like "tchack, tchack," several times repeated. Another call is "turnlee, turnlee," or "trallahee, trallahee."

Prof. F. H. King says he examined five specimens. Three had eaten seven beetles, among them three aquatic species; one, moths; one, two small mollusks; and two, small seeds (Geology of Wis., Vol. I., p. 551). They have been said to eat corn, but do no damage in Indiana.

117. GENUS QUISCALUS VIEILLLOT.

Subgenus QUISCALUS.

*195. (511b). *Quiscalus quiscula æneus* (RIDGW.).

Bronzed Grackle.

Synonyms, COMMON BLACKBIRD, CROW BLACKBIRD, PURPLE GRACKLE.

Adult Male.—Entire body, above and below, uniform and unvarying brassy-olive, or olive-bronze; wing shading gradually into bronze-purple, the primaries and tail more violet-purple; head, neck and jugulum, metallic brassy-green, steel-blue, violet or purple (according to individual), always very abruptly defined against the very different color of the back and breast. Bill and feet, deep black; iris, yellowish-white;

tail, conspicuously graduated. *Adult Female*.—Smaller; plumage much duller than in the male, the metallic colors less brilliant. *Young*.—Uniform grayish-dusky without metallic tints; iris, pale brown (Ridg.).

Male, length, 13.00; wing, 5.55-5.75; tail, 5.50-6.20. Female, length, 11.25-11.50; wing, 5.00-5.50; tail, 4.80-4.90.

RANGE.—Eastern North America, from Mexico and Gulf Coast to Louisiana, northward, between the Rocky Mountains and the Alle-



Bronzed Grackle.

(Beal.—Year-Book, United States Department of Agriculture, 1894, p. 233.)

ghanies; to Atlantic Coast in Massachusetts, Labrador and Great Slave Lake. Casually to Atlantic Coast from Virginia to Florida. Breeds from Gulf Coast, north. Winters from Indiana and Illinois, south.

Nest, often in colonies, in cavities or among branches of trees; of grass, weeds and mud; lined with grass or feathers. *Eggs*, 4-7; pale greenish-white to light rusty-brown, blotched and irregularly streaked with various shades of dark brown, and sometimes lavender; 1.14 by .82.

Common summer resident; most numerous in spring and fall in flocks. Sometimes in groves of cottonwoods, sycamores or other favorite trees, they are found breeding in companies, and there during nesting time the air is filled with harsh utterances and metallic notes.

Some winters they are found in favorable places within the State. Usually these are few, or even single birds, but sometimes they are present in small flocks. The winter of 1878-79, one of these birds remained about my home, at Brookville, feeding with the English Sparrows in the chicken yard and cornerib.

They occasionally remain in Monroe County (Evermann). The winter of 1896-7 they were reported from Hanover, January 11 (Culbertson). That winter they remained at Greensburg (Shannon), and at Bicknell (Chansler). Ulrey and Wallace say they are sometimes seen in mid-winter in Wabash County. They were found at Waterloo, January 18, 1890 (H. W. McBride), and Mrs. Hine says a flock of Blackbirds remained at Sedan all the winter of 1891-2, and the winter of 1893-4 they remained about Stony Lake. Mr. B. T. Gault saw a Blackbird of some kind in Cook County, Ill., in January, 1896; and Prof. A. J. Cook gives it, upon the authority of Mr. Warren, as having been seen in protected bottoms in St. Joseph County in January (Birds of Mich., p. 105).

Those that winter farther south begin to appear in great flocks in southern Indiana in February and early March. At night they roost in great numbers, associated with Red-winged Blackbirds and Cowbirds, in some selected spot. The evergreens in my yard have for years formed such a roosting place. They frequent it until the middle of April. The older, more shady towns of Indiana are selected for roosting places, both in spring and fall. The earliest and latest dates, respectively, of first appearance at Brookville are February 17, 1882, and 1890, March 11, 1889; they are usually common between March 8 and 14; at Sedan, February 27, 1893, and March 15, 1886; common between March 14 and 25; Petersburg, Mich., March 6, 1897, and March 18, 1891; common between March 15 and April 1; Cook County, Ill., March 23, 1886, and April 7, 1885. Again, will be observed the earlier arrival of a species near Lake Erie. Soon after arrival they begin a beautiful mating song. The birds gather at evening in groves and the shade trees of lawns, even in towns, and sing in great glee. This was continued in 1895 until April 28. I have seen them mating by March 9, 1887. In the Whitewater Valley they prefer groves of cottonwood, sycamore or other trees near water courses. Often they begin building in southern Indiana early in April. I have found their nests, apparently completed and occupied, by April 12, 1897, and in 1881 I found them nesting May 9.

Mrs. Hine reported their nesting at Sedan April 19, 1886, and Mr. L. T. Meyer says they usually breed in Lake County by May 15. The period of incubation is about two weeks, and both birds share that

labor. The young remain in the nest about eighteen days. Rarely a second brood is raised. After breeding, they begin to collect into small flocks. In 1896 they were first seen in flocks, coming into Greensburg to roost, June 5 (Shannon). In 1897 I observed the first flock in Brookville after breeding, June 16, and the next June 23. The greater number pass northward and return in immense flocks the first cold spell in September. September 3, 1897, they began to return in flocks, and added their clamor to the sounds of the town. The evening of September 21, a great flight of Blackbirds and Cowbirds was noted. The flocks followed each other so rapidly that there was almost a continual stream from northeast to southwest. Some years but few remain after late September. At Sedan they were noted October 17, 1889; October 29, 1891; October 13, 1892; October 27, 1894 (Mrs. Hine). At Brookville, November 14, 1884; November 9, 1887.

In nine specimens examined by Prof. King, the quantity of animal and vegetable food was about equal. Six had eaten corn; two, beetles; one, two water scorpions; one, a small crayfish; and one, a few seeds (Geology of Wis., Vol. I., p. 552. Dr. B. H. Warren, as the result of the examination of hundreds of stomachs of the Purple Grackle, through the period of their sojourn with him, extending over portions of seven years, shows that October is the month in which the greatest damage to corn is done. He says: "These examinations show that late in the fall, when insect food is scarce, corn is especially preyed upon by these birds, but during the previous periods of their residence with us, insects form a large portion of their diet" (Birds of Pa., 2nd ed., p. 222). With us it is rarely they do much damage to corn. But one or two instances have come to my attention during the time it is ripening, in twenty years. On the contrary, the industry the sable visitors show in spring in destroying the insects in the freshly broken ground, thereby exterminating a whole generation of the farmer's foes, much more than compensate for the little corn they eat. Mr. Thos. G. Gentry says they destroy the eggs and young of other birds, particularly Robins. In our State I am not familiar with such a habit.

XL. FAMILY FRINGILLIDÆ. FINCHES, SPARROWS, ETC.

- | | |
|---|--------------------|
| a ¹ . Mandibles crossed at tip. | LOXIA. 121 |
| a ² . Mandibles not crossed at tip. | |
| b ¹ . Head crested; bill, wings and tail chiefly red. | CARDINALIS. 137 |
| b ² . Head not crested. | |
| c ¹ . Bill very stout, its depth at base equal to length of hind toe with claw; length about three-fourths that of head. | COCCOTHAUSTES. 118 |

- c². Bill less stout, its depth at base less than length of hind toe with claw.
- d¹. Nasal plumules long, covering a third or more of upper mandible; bill stout, about one-half the length of head. PINICOLA. 119
- d². Nasal plumules, if present, covering less than one-third of upper mandible.
- e¹. Gonys distinctly convex in profile; plumage streaked above, not below; no white, red, yellow or blue. PASSER. 127
- e². Gonys straight or nearly so.
- f¹. Primaries much longer than secondaries, exceeding them by the length of the tarsus or more.
- g¹. Wing five times as long as short tarsus or more; under wing coverts red or yellow.
- k¹. Length 6.00 or more; wing over 3.50; plumage mostly white; hind claw nearly as long as bill. PLECTROPHENAX. 124
- k². Length under 6.00; wing under 3.50; tail forked.
- i¹. Nasal tufts nearly one-third the length of bill; tail feathers without white or yellow; adult plumage with more or less red. ACANTHIS. 122
- i². Nasal tufts short or none; tail feathers blotched with white or yellow; adult plumage with more or less yellow. SPINUS. 123
- g². Wing not five times as long as tarsus.
- j¹. Under wing coverts without red or yellow; bill not very stout.
- k¹. Depth of bill at base about equal to exposed culmen; nostrils partly covered by small tufts; no white on tail; male more or less red. CARPODACUS. 120
- k². Depth of bill at base decidedly less than length of culmen, tail partly white; no red.
- l¹. Tail forked, middle feathers pointed; hind claw nearly as long as bill, rather straight.
- m¹. Tail feathers, except middle pair, white; all, except outer pair, squarely tipped with black. RHYNCHOPHANES.
- m². Tail feathers not squarely tipped with black. CALCAEUS. 125
- l². Tail rounded; middle feathers not pointed; hind claw short and curved. CHONDESTES. 129
- j². Under wing coverts red or yellow; bill very stout. HABIA. 138
- f². Primaries not much longer than secondaries, exceeding them by less than the length of tarsus; plumage with no red.
- n¹. Colors generally blue, brown or greenish; not decidedly streaked or spotted.
- o¹. Length over 6.00; bill very stout; male blue with chestnut on wings; female plain brown. GUIRACA. 139
- o². Length under 6.00; bill not very stout.
- p¹. Male with blue or green; female mainly brown. PASSERINA. 140

- p*². Color slate or ashy; belly and first to third tail feathers white. JUNCO. 132
- n*². Colors plain, somewhere or everywhere streaked or spotted.
- q*¹. Tail with two to four outer feathers more or less white.
- r*¹. Length over 7.00; color above, male mainly black; female mainly brown. PIPILIO. 136
- r*². Length under 7.00; above brownish gray, streaked with black and brown. POECÆTES. 126
- q*². Tail with no white feathers.
- s*¹. Tail small and short; decidedly shorter than wings; or else tail feathers narrow and sharp pointed.
- t*¹. Size large; tail and upper tail coverts and wings mainly reddish brown. PASSERELLA. 135
- t*². Size smaller; not reddish brown as above.
- u*¹. Breast more or less yellow; male with black patch. SPIZA. 141
- u*². Breast not yellowish; spotted or striped above and below, or with narrow sharp pointed tail feathers, or both. AMMODRAMUS. 128
- s*². Tail as long as or longer than wing, or tail forked; or head with black and white, or brown and lighter brown stripes.
- r*¹. Tail forked, middle feathers shortest; adults not streaked or spotted below. SPIZELLA. 131
- r*². Tail not forked, the middle feathers not shortest.
- w*¹. Plumage streaked or spotted below, or crown chestnut. MELOSPIZA. 134
- w*². Plumage not streaked nor spotted below; or crown with black and white; or brown and lighter brown stripes.
- r*¹. Wing over 2.75; head striped in adults, chestnut in young. ZONOTRICHIA. 130
- x*². Wing under 2.75; edge of wing yellow. PEUCÆA. 133

118. GENUS COCCOTHAUSTES BRISSON.

Subgenus *HESPERIPHONA* Bonaparte.196. (514). *Coccothraustes vespertinus* (COOP.).

Evening Grosbeak.



Evening Grosbeak. (Reduced.)

Male.—Above, olive-brown; line over eye, forehead, wing coverts and rump, yellow; crown, primaries and tail, black; secondaries, mostly white; below, yellowish, darkening to olive-brown on the throat; outer tail feathers, sometimes more or less white; bill, very large, greenish-yellow. *Female*.—Above, top of head, brownish-gray; rest of upper parts, grayish, tinged more or less with yellowish; a whitish patch at base of primaries. *Immature*.—Similar to female, but duller.

Length, 7.00-8.50; wing, 4.20-4.50; tail, 2.75-3.20.

RANGE.—Interior of North America, from Rocky Mountains east to Great Lakes and northward. Casually, to the Atlantic Coast, and southward, in winter, irregularly, into Nebraska, the Ohio Valley, Indiana and Kentucky, Pennsylvania and Connecticut.

Nest, in tree; of sticks, twigs, rootlets. *Eggs*, 3-4; greenish, blotched with pale brown. This description is of the nest and eggs of the western form, which has been separated from this. They are undoubtedly similar.

Very irregular winter visitor; sometimes found in numbers. These birds, whose home is in the dark coniferous forests of the Northwest, some winters range eastward and southward, until they reach the Atlantic Coast. Such, however, is unusual, but every few years they have been found in Indiana.

JFW

In Illinois they were observed at Freeport during the winter of 1870-71, and at Waukegan, in January, 1873 (Hist. N. A. Birds, Baird, Brewer and Ridgway). The winter of 1871 they were quite common throughout the northern portion of that State. The following winter they were much rarer, and since then but very few have been seen (Nels. Bull. Essex Inst., Vol. VIII., 1876, p. 104).

About the year 1872, while hunting in the autumn, near Eureka, Woodford County, Ill., Prof. O. P. Hay came upon a flock of these birds and killed six (Bull. Nuttall Orn. Club, July, 1881, p. 179). Mr. T. McIlwraith records its occurrence in Ontario, at Toronto, December 25, 1854, and at Woodstock, in May, 1866. In 1871 they were also found near London, and he noted them near Hamilton, March 17, 1883 (B. of Ont., 1894, p. 291). Dr. Kirtland noted its occurrence near Cleveland, O., in March, 1860 (Wheaton, Birds of O., p. 314). Dr. Morris Gibbs has informed me of the occurrence of this species in Michigan in 1869, 1872, 1873, 1874, 1878 and 1879.

During none of these visits, except that of 1878, does it seem to have been identified in Indiana.

The first reference to its occurrence in this State I find in *Forest and Stream*, Vol. VI., 1876, p. 148, where Mr. G. Aug. Smith says: "It occurs some winters at Ft. Wayne." In the collection of Purdue University, Lafayette, Ind., is a specimen taken near that city in November, 1878 (C. R. Barnes). This is the first verified record for Indiana. In 1883, they were next noted. Five specimens were shot at Whiting Station, Ind., December 20, 1883 (H. K. Coale). Mrs. A. W. Brayton has a specimen which she informs me was taken in the summer of 1886, near Allisonville, twelve miles north of Indianapolis. The winter of 1886-7 they ranged eastward into Ontario, as far as London, and south into Iowa to Fulton County, Ky., and over much of Indiana, as far, at least, as Bloomington, where the late Mr. C. H. Bollman and Mr. G. G. Williamson obtained several specimens. That winter they were first recorded in Indiana from Lake George, December 5, 1886, when two females were taken, which are now in the collection of Mr. G. Fream Marcom, San Diego, Cal. Messrs. H. K. Coale and Geo. L. Toppan reported seeing two January 1, 1887. January 14, Mr. Toppan reported two males near Chicago. January 20, Mr. C. H. Bollman took one male near Bloomington. The same day, Cal. Meredith and another boy shot five from a flock of twelve, near Frankfort (C. E. Newlin). March 25, Mr. Oscar Vaught shot two from a flock of eight or ten near Mace.

In Mr. Morcom's collection I saw six males and two females, two of which were kindly given to me, marked Berry Lake, Ind., April 3,

1887; also four males from the same locality, April 18, 1887, and a male and a female, dated May 10, 1887.

Mr. G. G. Williamson noted the following specimens at Bloomington, in April, 1887; April 27, one; 29, two; 30, two. Mr. C. A. Stockbridge, of Ft. Wayne, has a specimen taken from a flock of eight or nine near that city, about May 6, 1881. Mr. R. Turtle, a taxidermist of Chicago, showed me a number of these birds, of which he said he killed ten, May 8, 1887, at Berry Lake, Ind., and thirteen May 10, at Whiting. Mr. Turtle obtained a large number of specimens the preceding winter from Whiting. The latest record I have of its occurrence in spring is May 13, 1887, when it was found in Lake County.

The winter of 1888-9, although they were observed in Michigan and Illinois, none were reported from Indiana. The year 1889-90, they appeared at Madison, and other places in Wisconsin, by November 20, 1889. They reached Ohio and Pennsylvania in December, and in January, February and March were found reaching almost to the Atlantic Coast. Dr. Warren says they remained in some parts of Pennsylvania until May 15, 1890 (Birds of Penn., Rev. Ed., 1890, p. 225). In Indiana this movement was not so noticeable. Mr. H. N. McCoy obtained a specimen from a flock of twenty or thirty near Lafayette, February 1, 1890. Mr. L. T. Meyer reported them from Whiting, Lake County, in January and February. Dr. A. W. Brayton identified a specimen taken near Indianapolis that winter. Mr. C. A. Stockbridge saw them at Ft. Wayne, February 15 and 16, 1890. After the last date they became common, and he took one as late as April 12 of that year. Messrs. Ulrey and Wallace say there are two pairs in the collection of Mr. M. L. Galbraith, Collamer, Indiana. They were taken in Whitley County. Mrs. Jane L. Hine informs me a gentleman in Steuben County has an Evening Grosbeak that was taken in the southern part of that county.

Their food is principally elm buds, maple buds and seeds, and especially the buds, more rarely the seeds, of the box-elder (*Negundo aceroides*). This last is most commonly eaten in early winter, the others all through their stay with us. They resemble clumsy Cross-bills when extracting the seeds of this tree. They also eat fruit of the climbing bitter-sweet. They are loth to leave a woods heavy with maple "mast." Early in May they have been known to turn their attention to the pine trees. One instance is recorded of their eating frozen crab-apples, that remained on the trees until mid-winter. In addition to evergreens, maple, beech and elm woods, they frequent orchards, where apple seeds are favorite food. They gather food from

the trees and also pick it off the ground. When on the ground feeding, they are quite silent. They move by hopping, holding themselves like robins, and turn over the leaves with great dexterity, picking up the seeds from under them. The males have a loud call note, a sharp, metallic cry like the note of a trumpet, which they utter frequently when excited. The females chatter like Bohemian Waxwings (*Ampelis garrulus*). Their song towards spring is a rambling, jerky warble, beginning low, suddenly increasing in power, and as suddenly ceasing, as though the singer were out of breath. They are usually found in flocks of six to twelve individuals. Sometimes, however, there are twenty or thirty in a flock. It is but rarely that full plumaged males will be found among them. During the more severe part of the winter, they are usually tame and unsuspicious; this sometimes continues through their stay, but they often become shy before they leave. Sometimes, when one is shot, all will leave; usually, however, they will remain until a number are killed before taking flight. Their flight through the woods is very swift, reminding one, by the dexterity with which they avoid branches, of a Pigeon; when in the open, it is more like that of a Blackbird (See Butler, Some Notes Concerning the Evening Grosbeak, *The Auk*, Vol. IX., pp. 238, 247. Further notes on the Evening Grosbeak, *The Auk*, Vol. X., April, 1893, pp. 155-157; also Proceedings of the Ornithological sub-section of the Biological Section of the Canadian Institute for 1890-91.).

119. GENUS PINICOLA VIRILLOT.

197. (515). Pinicola enucleator (LINN.).**Pine Grosbeak.**

Adult Male.—Carmine; paler ashy on the belly; darker and streaked with dusky on the back; wings and tail, dusky, the former much edged with white and with two white bars. *Adult Female*.—Ashy; paler below; head, back and lower parts, brownish, shaded with olive; rump, olive-yellow; wings, similar to those of male. *Immature*.—Similar to female, but more ashy.

Length, 8.25-9.00; wing, 4.50-5.00; tail, 3.70-4.45.

RANGE.—Northern parts of Northern Hemisphere. In America, breeding from Maine, Quebec and mountains of Colorado northward. In winter, irregularly into northern United States, rarely as far as northern Illinois, northern Indiana, Pennsylvania, New York and southern New England.

Nest, in coniferous trees; of twigs and rootlets, lined with finer materials. *Eggs*, "usually 4; pale greenish-blue, spotted and blotched with dark brown surface markings, and lilac shell spots; 1.05 by .74."

Irregular or accidental winter visitor. Mr. J. W. Byrkit identified it at Michigan City. Mr. C. A. Stockbridge informs me there is a specimen in the collection of Prof. H. Duemling, Concordia College, Ft. Wayne, Ind., that was taken near that city by the late Mr. G. Aug. Smith. It was observed at Waukegan, Ill., Jan. 2, 1884 (Ridg., *Birds of Ill.*, I., p. 224). Mr. Geo. L. Toppan once noted it in Lake County, Ind., and thinks it was in the winter of 1884-5.



Pine Grosbeak. (Reduced.)

Mr. F. M. Woodruff writes that a few days before January 1, 1896, Mr. John F. Ferry took a number of specimens from a flock of Pine Grosbeaks at Lake Forest, Ill.

Mr. L. O. Pindar reports it from Fulton County, Kentucky, several times between February 7 and March 19, 1888 (*The Auk*, July, 1888, p. 321).

They were seen in flocks of thousands in Jackson County, Mich., in 1881, and were very tame. Jackson County is only one county removed from Indiana. With that exception, they are reported as rare in southern Michigan. They are found far north, where Mr. Nelson says they withstand the cold of these forests even within the Arctic Circle. Wherever found they appear in flocks, the greater part of which are young and females. Adult males are few some writers say, from one to ten or fifteen of the plainer-colored birds. Their disposition is agreeable, social and gentle. The fruit of the red cedar and berries of the mountain ash are favorite foods along the southern portion of their winter range.

120. GENUS CARPODACUS KAUP.

198. (517). *Carpodacus purpureus* (Gmel.).

Purple Finch.

Adult Male.—Crimson, rosy or purplish-red, most intense on the crown, fading to white on the belly, mixed with dusky streaks on the back; wings and tail, dusky, with reddish edgings, and the wing coverts tipped with the same; lores and feathers all around the base of the bill, hoary. *Female and Young*.—With no red; olivaceous-brown, brighter on rump, the feathers above all with paler edges, producing a streaked appearance; below, white, thickly spotted and streaked with olive-brown, except on the middle of the belly and under tail-coverts; obscure whitish superciliary and maxillary lines. *Young males* show every gradation between these extremes in gradually assuming the male plumage, and are frequently brownish-yellow or bronzy below.

Length, 5.50-6.25; wing, 3.15-3.40; tail, 2.30-2.50.

RANGE.—Eastern North America, from Gulf of Mexico north to Labrador and Saskatchewan. Breeds from Illinois and Pennsylvania northward. Winters from Indiana and Pennsylvania southward.

Nest, usually in evergreen; of weeds, grass, bark shreds, vegetable fibre; lined with hair. *Eggs*, 4-5; pale green, with spots and irregular lines of dark-brown and lilac, chiefly towards the larger end; .85 by .65.

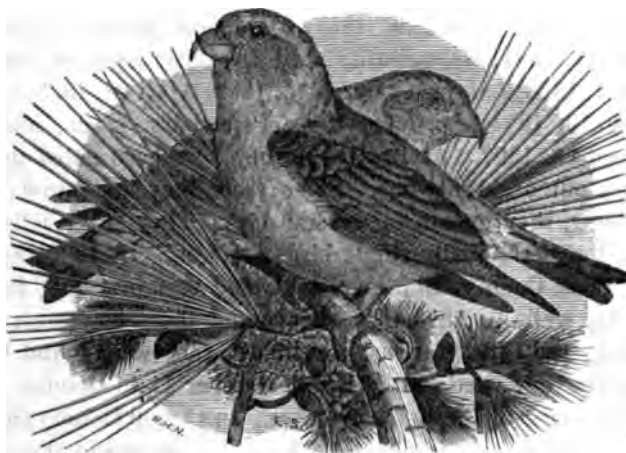
These birds, when not in full plumage, more nearly, both in shape and coloration, resemble the English Sparrow than any of our native birds. They are often killed for the saucy foreigners by those who do not distinguish them.

The Purple Finch is a regular migrant in varying numbers, and is irregularly a winter resident, even to the northern limits of the State, in favorite localities. In northern Indiana they may possibly be found occasionally to remain through the summer. The winter of 1887-8 a company of these birds remained all winter near Sedan, DeKalb County, and a number more were found in the same woods through November, 1891 (Mrs. J. L. Hine). They were found January 9, 1896, at Lake Forest, Ill.; January 25, 1879, in Carroll County; January 21, 1894, and through the winter of 1894-5 at Greencastle, Ind.; December 15, 1894, in Johnson County. Prof. W. W. Cooke says they breed in northern Illinois, eggs having been taken at Polo, Ill. (Bird Mig., Miss. Val., p. 179). They have also been taken at Waukegan in the breeding season (Nehrling, N. A. Birds. Pt. IX., p. 31). Prof. A. J. Cook reports it breeding at Lansing, Mich. (Birds of Mich., p. 107).

They are most common during the spring migrations in March and April, being also occasionally seen in February and early May, and in fall in October, though they may be noted rarely as early as late August and late into November. The following dates give respectively the earliest and latest date of first arrival and the latest date of departure in spring at the places noted: Vincennes, March 4, 1897; Red Key, February 15, 1895; Brookville, February 26, 1892; April 25, 1881, 1887; depart, April 30, 1887; Richmond, March 20, 1892; depart, May 11, 1897; Greensburg, April 23, 1893; April 30, 1896; depart, May 7, 1893; Lafayette, March 13, 1897; April 28, 1895; Chicago, Ill., April 12, 1884; April 28, 1885; Petersburg, Mich., March 17, 1889; April 23, 1897. At Brookville they have been noted in spring nine years out of twenty-one. Some years they are found but for a day; others, they remain for several days. They are usually found in flocks, but occasionally single birds are seen. In 1896 they were noted in Cook County, Ill., August 21, and remained that fall until October 31, while in 1895 they were found there November 4. At Greensburg, Ind., the year last mentioned, they were found October 26. In 1894 they were seen at Sedan October 11 to October 31, and in 1891 were present through November. In Carroll County they were noted from October 12 to October 19, 1878. In spring they may be noted as feeding upon the opening buds of the elms, particularly the red elm, of which they seem to be very fond.

They may be found wherever elms grow, and prefer less dense woods or the straggling trees along smaller waterways. Sometimes they are quiet while feeding. In April, however, their voices may often be noted reaching through the woodland for a considerable distance. To me, the song somewhat resembles that of the warbling vireo. The song is a beautiful liquid utterance, and I fancy it as the beginning of the nuptial courtship. They usually nest in cedars, spruce or other evergreens, but occasionally build in apple trees. In height, they are found from 5 feet to 50. The nests are placed upon a limb among the twigs. The nest is shallow and composed of vegetable fibres, grass, shreds of bark; sometimes they are nicely woven and lined with a well-woven mat. In the fall they feed upon seeds, being especially fond of hemp and sunflower seeds.

121. GENUS LOXIA LINNÆUS.

α¹. Wing with no white.**L. curvirostra minor** (Brehm.). 199α². Wing with white.**L. leucoptera** Gmel. 200**199. (521). Loxia curvirostra minor** (BREHM.).**American Crossbill.**

American Crossbills—Male and Female. (Reduced.)

Adult Male.—Bill, crossed; above, brick-red; wings, blackish, unmarked. **Female.**—Brownish-olive, streaked and speckled with dusky, the rump saffron. **Immature Males.**—Mottled with greenish and greenish yellow.

Length, 5.50-6.25; wing, 3.20-3.60; tail, 1.85-2.40.

RANGE.—Northern North America in winter; south irregularly to South Carolina and Louisiana. Of irregular occurrence south into the Ohio Valley in summer. Breeds along the Alleghanies from the northern United States and occasionally to Georgia.

Nest, in evergreen trees; of evergreen twigs, bark; lined with horse-hair, fine rootlets, grass and feathers. **Eggs,** 3-4; pale greenish, spotted and dotted, mostly at larger end with various shades of brown and purplish; .75 by .57 (Bicknell, N. O. C., Vol. V., pp. 7-11).

A very erratic bird. When found is generally noted as a winter visitor or migrant in flocks; less common in southern Indiana; some winters wholly wanting. They are sometimes found singly in company with Pine Siskins. Prefers localities where pines or other coniferous trees are found. There they sometimes remain quite well into the summer, and are reported to breed.

Dr. Haymond makes no record of the Crossbill in his list of 1856, and the first account at hand is that of Dr. Wheaton, who noted it from Ohio in the winter of 1859-60. Dr. Haymond included it in his report of the birds of Franklin County in 1869. That year and the succeeding, Mr. C. E. Aiken observed them in Lake County, Ind., and Cook County, Ill. They were not again observed in Indiana until the winter of 1882-3, when they spread over Indiana and reached at least to Nelson County, Ky. (Beecham, p. 24). That winter they were reported by Prof. Evermann from Monroe and Carroll counties, and Mr. E. R. Quick and myself took them at Brookville.

The three succeeding winters they were noted in different parts of the State, as far south as Bloomington. In May, 1887, they were reported from Lake County. The succeeding fall they were found at Brookville from October 29 to November 19, and from there and Terre Haute northward were reported the following winter and spring. The winter of 1888-9, they were found over western Indiana, as far south as Vincennes. From that time until 1897, when they were noted at Lafayette, they were not reported from the State in winter. They were, however, reported as migrant in the spring of 1890, 1891, 1892, and 1895, and in the fall of 1894; Wabash, September 11, 1894 (Ulrey and Wallace). When they visit us, they usually arrive in late October or November, and pass northward in March and April. Sometimes, however, they remain much later. Mr. C. E. Aiken tells me they became very abundant in the vicinity of Chicago, including Lake County, Ind., in July and August, 1869, and remained until late in the fall. They fed greedily on sunflower seeds, and were so sluggish that one could approach within a few feet of them, so that they fell an easy prey to boys with catapults. He says they were not rare the succeeding year in the vicinity of Chicago. The summer of 1878 they were found at Columbus, O., and abundantly at Cleveland, O. In 1885 they remained at Bloomington until May 12; in 1886 they were noted July 10, 13, and 14. They have also been noted in summer at Muncie, May 4, 1888; Greencastle, July 27, 1891; Bainbridge, July 11-15, 1892; Lafayette, March 11 to June 30, 1892; March 30 to May 22, 1895; February 22 to May 24, 1897. For the notes from Lafayette I am indebted to Messrs. L. A. and C. D. Test.

In the summer of 1878 they were reported to have bred in the vicinity of Cleveland, O. Dr. Wheaton reports it having been known to nest in Indiana (Ohio Geol. Survey, Vol. IV., 1879, p. 317). Mr. E. M. Kindle informs me that Mr. Sam Hunter reported a pair of these Crossbills to have bred at Bloomington, Ind., in 1885. The nest was said to have been placed in a pine tree and was made ex-

clusively of pine burrs. Mr. R. B. Moffit informs me they nested at West Lafayette, in 1885, and that young birds were taken there.

Dr. H. A. Atkins is said to have taken their nests near Locke, Mich., July 13, 1880. They are said to nest early, often in February, while the snow still covers the earth, but they have been found nesting until into July.

They feed principally upon the seeds of conifers, which they extract from the cones. The crackling of these burrs was what first called my attention to the Crossbills. They uttered no note, but busily tore off the plates and picked out the seeds. The sound resembled the crackling noise made by the opening of the cone left on the tree under the warping influence of a warm spring sun. They sought their food both upon the tree and upon the ground beneath it. They were very tame, permitting me to approach quite close to them, apparently unnoticed. When they took wing, they uttered a note which Mr. Otto Widmann has compared to the "parent call of *Progne*," our Purple Martin. Mr. Widmann informs me that they were attracted to the vicinity of Old Orchard, Mo., partially by the abundance of apples left on the trees the winter of 1891-2. These, I presume, formed part of their food. They also eat elm buds in May. They also eat the seeds of horse-weeds. Mr. Jesse Earlle found a male in breeding plumage and four other Crossbills in dull plumage apparently probing the mud about the borders of a mill pond near Greencastle, July 27, 1891. The specimen first mentioned he shot. But a small proportion of the birds seen—as they move about in flocks of varying size—are males. Mr. Nehrling says its song consists of a number of loud, flute-like notes which are frequently intermingled with several harsh chattering tones (N. A. B., p. 41). (See Butler. The range of the Crossbill in the Ohio Valley, with notes, on the unusual occurrence in summer. Papers read at the World's Congress of Ornithology in Chicago, 1893-1896, pp. 47-58, and Proc. Indiana Acad. Sci., 1892, pp. 63-72.)

200. (522). *Loxia leucoptera* GMEL.

White-winged Crossbill.

Wings in both sexes, with two conspicuous white bars; bill, crossed. *Male*.—Rosy-red. *Female*.—Brownish-olive, streaked with dusky, the rump saffron. *Immature Males*.—Mottled as in last species.

Length, 6.00-6.50; wing, 3.50; tail, 2.60.

RANGE.—Northern North America, south in winter to northern Indiana and Pennsylvania, rarely to Kansas, southern Ohio and Virginia. Breeds from northern New England and northern Rocky Mountains north.

Nest, of twigs and strips of birch bark, covered externally with moss (*Usnea*), and lined with soft moss and hair; in an evergreen in deep forest. *Eggs*, 3 (?); pale blue, spotted and streaked near larger end with reddish-brown and lilac; .80 by .55. (Chamberlain).

These Crossbills are more rare than the preceding species, but their visits are of the same irregular character. Usually they are found in flocks. They often accompany the common Crossbill, and may be looked for at the same time in similar localities. The habits of the two birds are similar.



White-winged Crossbill. (Reduced.)

Dr. J. M. Wheaton mentioned it in his catalogue of the Birds of Ohio, in 1861. In the winter of 1868-9, Mr. Chas. Dury found this and the last mentioned species together in the vicinity of Cincinnati in large flocks in the proportion of two of that to one of this species. Mr. C. E. Aiken reports the first record of the White-winged Crossbill from Indiana. The summer of 1869, in the vicinity of Chicago, in Cook County, Ill., and Lake County, Ind., he found this species in company with the last, and they remained throughout the winter succeeding. About 1878 a pair of these birds was taken at Ft. Wayne. The female is now in the collection of Mr. C. A. Stockbridge, who has kindly permitted me to examine it.

Mr. Fletcher M. Noe reports its occurrence near Indianapolis early in 1883. February 6, 1883, Prof. B. W. Evermann shot two males from a flock of fifteen of these birds at Bloomington. Others were taken February 10 and 12. Mr. J. W. Byrkit found both species together at Michigan City the winter of 1883-4. Miss H. E. Colfax informs me of its occurrence there as late as June 26, 1884. Mr. Chas. Dury reports it from Michigan City, he thinks, 1885. Hon. R. Wes. McBride reports it in Dekalb County, where Mrs. J. L. Hine tells me

Mr. McCord shot two in the court-house yard at Auburn, March 8, 1885. Prof. B. W. Evermann killed a female with a stick, the only one seen, at Burlington. Another female was seen at Camden, March 16, 1885. The only instance of its occurrence in summer in the Ohio Valley is that given me by the late Mr. C. H. Bollman. He saw eleven on a fir tree in Bloomington, Ind., June 24, 1886. This species has been found breeding in Maine, in winter. Mr. H. Nehrling mentions a nest having been found April 21, 1891, in Delta County, Mich. Nests of this species have been but rarely found, and are still desirable in collections. (See same papers referred to at end of last species.) In addition to the same kind of food eaten by the other species, they are said to eat decayed garden fruits, the seeds of beech, grass and canker worms. They have a chattering note, uttered when they fly, and in their breeding grounds have a song, which is described as low, sweet and disconnected.

122. GENUS ACANTHIS BECHSTEIN.

♂¹. Wing 3.00 or less; tail 2.50 or less. **A. linaria** (Linn.). 201

♂². Wing usually over 3.00; tail 2.60 or more; bill much larger and stouter.

A. linaria rostrata (Coues.). 202

201. (528). **Acanthis linaria** (LINN.).**Redpoll.**

Adult Male.—Above, streaked with dusky and flaxen in about equal amounts; crown, with a patch of crimson; rump and breast, pink; throat, with a black patch; belly, dull white, sides streaked; wings, brownish-dusky, with two white bars. *Adult Female*.—Without pink on breast and rump. *Young*.—Head, neck and breast, streaked, and showing no red or pink. Bill, pointed and yellow.

Length, 4.50-5.00; wing, 2.70-2.80; tail, 2.30-2.35. Bill, length, .32-.36; depth at base, about .20-.25; tarsus, .52-.55.

RANGE.—Northern part of northern hemisphere in North America; south, irregularly in winter to Kansas, Indiana and D. C. Breeds far north.

Nest, in low tree or bush; of grass and moss, lined with plant-down and feathers. *Eggs*, 4-6; pale bluish or greenish-white speckled with reddish-brown; .67 by .48.

The little Redpoll is an irregular winter visitor. Some years they occur in immense numbers in the northern part of the State. Possibly it is to be found there most every winter, but in the southern portion of the State it is rare.

Mr. Chas. Dury took a single specimen in the vicinity of Cincinnati in January, 1869. The first record for Indiana is a specimen taken by Prof. B. W. Evermann, at Camden, November 5, 1878. From southern Indiana there are but few notes. Dr. C. R. Case noted it in flocks in Franklin County, February 10, 1881. Prof. Evermann identified a single bird at Bloomington in December, 1882. Mr. E. L. Guthrie obtained specimens in Decatur County the winter of 1883. Mr. Chan-
cey Juday obtained specimens from a flock of twenty at Bloomington, April 12, 1895. They have also been reported as follows in winter: That of 1889-90, they were distributed generally over the northern part of the State in some numbers, having been reported from Benton, Wabash, Allen and Dekalb; 1892-3, there were many about Elkhart; 1895-6, they were tolerably common in Cook County, Ill., and Lake County, Ind.; 1896-7, they seem to have been generally distributed northward, having been reported as common in the vicinity of Chicago; noted at different times in Lake County and common in March at Sandusky, O.. There is a specimen in the State Museum at Indianapolis, from Boone County, Ind. The earliest date of arrival in fall is October 24, 1896, when they appeared commonly at Chicago. They remained in that vicinity in 1885 until April 26.

While often found among the evergreens, they also frequent weed patches, eating the seeds, after the manner of the American Goldfinch. They are easily frightened from their feeding grounds, but soon return, uttering a soft call, as if to reassure each other. Mr. H. Nehrling observed them in 1875-6 at Oak Park, Ill. He says: "Without fear, they came under the kitchen windows, picking up millet, canary seed and crumbs of bread. The weeds in the garden (a species of *Ambrosia*), and the hemp stalks, were thoroughly searched for food. Like Titmice, they climbed, head downward, along branches of shrubs and weed stalks, always uttering a peculiar chett, or chett-cherrett" (Birds N. A., X., p. 51). They are very tame and unsuspicious when undisturbed, but when frightened become wild. Their flight is not high, and the scattered flocks move along in undulating lines. The late Dr. Kirtland, of Ohio, records a crippled Redpoll which came into his possession in the winter of 1868, that ate crumbs of bread and hayseed, and rapidly recovered. It learned to live exclusively upon the parasitic insects of house plants, and did so until it escaped in the spring.

202. (5286). *Acanthis linaria rostrata* (COUES).**Greater Redpoll.**

Similar to *A. linaria*; usually more heavily streaked on sides, and all the dimensions larger.

Length, 5.25-5.75; wing, 3.00-3.30; tail, 2.60-2.70; bill, .41-.47; depth of bill at base, .25-.30; tarsus, .65-.70.

RANGE.—Greenland and northeast North America; south, irregularly in winter—to New England, New York, Ontario and northern Indiana and west to Manitoba.

This species, which is said to be common in Greenland, occasionally reaches in its winter wanderings as far southwest as Ontario, Michigan, Illinois and Indiana.

Different forms of Redpolls are associated in flocks, but this and the preceding are the only ones that have been taken in Indiana. Mr. H. K. Coale obtained a specimen of this Redpoll (No. 5340, Mus. H. K. C.) at Davis Station, Starke County, Ind., January 1, 1884. It was found with a flock of Redpolls (*A. linaria*), feeding—eating seeds of weeds, the tops of which protruded through the snow. Mr. Coale had taken a specimen November 21, 1878, in Cook County, Ill., near the Indiana line, which was the first Illinois record. These birds were reported as *Acanthis linaria holbæillii*, but evidently are this form. Its habits are similar to that of its more common relative.

123. GENUS SPINUS KOCH.

a¹. Inner webs of tail feathers with white patch; plumage not streaked.

***S. tristis* (Linn.). 203**

a². Inner webs of tail feathers without white patch, but with yellow bases; plumage streaked.

***S. pinus* (Wils.). 204**

203. (529). *Spinus tristis* (LINN.).*American Goldfinch.**

Synonyms, YELLOW BIRD, LETTUCE BIRD, SALAD BIRD.

Adult Male.—Bright gamboge-yellow; crown, wings and tail, black; lesser wing-coverts, band across the greater ones, ends of secondaries and tertiaries, inner margins of tail feathers, upper and under tail-coverts and tibia, white. *Female*.—Yellowish-gray, above; greenish-yellow, below; no black on forehead; wing and tail much as in male. *Young*.—Reddish-olive, above; fulvous yellow, below; two broad bands across coverts, and broad edges to the last half of secondaries, pale rufous (B., B. and R.).

Length, 4.45-5.40; wing, 2.60-2.90; tail, 1.80-2.10.

RANGE.—North America, from southern California and Gulf coast north to Labrador, Manitoba, and British Columbia. Breeds from Virginia, Kentucky and Kansas, northward. Winters from southern Ontario and northern United States, southward.

Nest, usually in upright fork of tree or bush, 5 to 25 feet up, a neat structure of grass, bark strips and plant fibres, closely woven, and lined with plant down. *Eggs*, 3-6; pale bluish-white; .65 by .52.

Resident; rare some winters, northward. Most persons fail to recognize the bright, black-winged, black-capped yellow bird of May and June in the mottled plumage of September. In spring the bright plumage is taken on, and in September the duller winter plumage begins to replace it. During the greater part of the year these birds associate in flocks, wandering about as they are attracted by desirable food. While these birds are always present, the same individuals are not. Those which winter with us pass northward, and the bright-colored ones, who have changed their dress farther south, come upon us quite suddenly, with the bursting of the apple blossoms each spring. They usually come to the Whitewater Valley in the latter part of April, but, in 1883, arrived April 12, and in 1884, not until April 30.

With the advent of those in brighter colors, the ones which have been feeding upon the buds of elms and other early flowering trees, leave. They do not mate upon arrival, but postpone their nesting until quite late. The earliest I observed them mating was May 9, 1887. Nests may generally be looked for after July 1, but sets of eggs are sometimes found in August and September. Their song is an ecstatic effort that is very pleasing. It is loud and has a peculiar flute-like quality that adds attractiveness to its brilliant effort. The strain may be written thus: chit, chit, chit-o-ree-e, repeated with trills and expressions indescribable. Besides, it is continued into July and sometimes August, and becomes more conspicuous, because many of its rivals have, long before that, ceased to sing. In 1897, I last heard it July 22. As it gallops through the air, apparently riding the wind-waves, its rhythmic note has been interpreted by Mr. F. M. Chapman as "per-chic-o-ree," "per-chic-o-ree." When feeding in spring among the tree-buds, it has a note, "co-ree," "co-ree," which a number sometimes utter together. But all through the year they have a soft "tweet" that readily distinguishes them. They are the seed destroyers par excellence. Sometimes it is something desirable, like the seed of lettuce, turnip and hemp, but more often it is the baneful dandelion, burdock, mullein, and other pernicious weeds. Sunflower seed is a

favorite food. In winter the seeds of grasses, rag-weeds, horse-weeds, and occasionally sycamore, are eaten.

They are very tame. In summer they often make their homes in orchards, lawns, and even among the fruit and shade trees of our towns. In autumn the garden is a favorite place. In winter they are often found about the barnyards and adjacent shrubbery.

Prof. F. H. King examined 34 stomachs and found they had eaten 20 plant lice, and the remainder of their contents was chiefly weed seeds. He says the service which the Thistle Bird does in destroying the seeds of the almost uncontrollable Canada Thistle throughout the Eastern and Middle States must be very great (Geol. Wis., I., p. 535). Dr. Wheaton says they eat the Hessian Fly.

204. (533). *Spinus pinus*. (WILS.).

Pine Siskin.

Synonym, PINE FINCH.

"Tail deeply forked; above, brownish-olive; beneath, whitish, every feather streaked distinctly with dusky; concealed bases of tail feathers and quills, together with their inner edges, sulphur-yellow; outer edges of quills and tail feathers, yellowish-green. Two brownish-white bands on the wing. Sexes alike. *Young*.—Similar, but the white below tinged with yellow, the upper parts with reddish-brown, and there are two pale ochraceous bands on the wing."

Length, 4.50-5.25; wing, 2.75-2.90; tail, 1.85-1.95. (B. B. and R.).

RANGE.—North America, from Mexico (Vera Cruz) north into British provinces. Breeds from south New England, New York, the southern limit of its range in Mexico, northward, but mostly north of United States.

Nest, in coniferous trees, of grasses, rootlets (near settled places, string, threads, etc.); lined with finer material of the same kind, hair and feathers. *Eggs*, 4; pale bluish-white, spotted and blotched with reddish or dark brown, vinaceous, sometimes lines of same color; .61 by .47.

More or less regular winter migrant, and rare winter resident. Sometimes found in great numbers, in flocks, occasionally associating with Goldfinches, in winter, and with Purple Finches, in spring. They resemble the Goldfinches in action, in fall and winter, too, but not in song. Their note is a single wheezy syllable, which may be expressed as "Cree," sometimes highest at the end, again highest on the first vowel, and falling towards its close. Some years they arrive in October, others in November. They arrived at Wabash early in October,

1896, and were found in abundance into November. They also were noted at Bloomington. The earliest arrival at Brookville is October 14, 1896. That fall and the succeeding spring they were generally distributed in the Whitewater Valley, but were not abundant. November 17, 1882, I found them everywhere along the Whitewater River bottoms in countless numbers.

Roadsides, fence rows, weedy banks and thickets, corn and stubble fields, all were alive with their fluttering wings, while the crackling of weed seeds and their peculiar note added voice to the scene. They were present in great numbers throughout the winter. Were last seen April 27. Some years they are not seen after February or March; others, they remain until late April or May. In spring they frequent the evergreen trees about our homes, as well as the native cedar, where they sometimes are found in company with the Crossbills; also, elms, maples, apple, and other deciduous trees, where they, with habits somewhat resembling the Purple Finches, associate with them while feeding. The spring of 1885 they remained at Brookville until May 11, while the spring of 1887 they generally remained, not leaving until May 5. They were remarkably abundant at Richmond, where they remained until May 24 (Hadley); Lafayette, May 29 (L. A. and C. D. Test); Petersburg, Mich., May 12 (Trombley). Dr. Jordan took a specimen near Indianapolis in midsummer (Brayton). One was observed at Wabash, with Goldfinches, several times between June 10 and 20, 1892. They were feeding on mulberries (Wallace). The last ones to remain in spring are very shy. They frequent the higher evergreens in little companies, and, after sitting quietly for a time, all utter their lisping "cree" together, sometimes repeating it two or three times. After an interval of silence they repeat the call. Dr. Wheaton thought it probable it breeds in northern Ohio, and Davie gives it as breeding in Michigan (Nests and Eggs of N. A. Birds, 1889, p. 293). Nests, with eggs, have been found from near the first of May until near July 1. Dr. A. K. Fisher took a nest of this species at Sing Sing, N. Y., May 25, 1883 (See Ridg., B. Ill., p. 289).

124. GENUS PLECTROPHENAX. STEJNEGER.

205. (534). *Plectrophenax nivalis* (LINN.).

Snowflake.

SYNONYMS, SNOW BUNTING, WHITE SNOWBIRD.

Adult, Breeding Plumage.—White, middle of back, terminal half of primaries, and tertiaries, and two middle tail feathers, black; legs and bill, black. *Adult in Winter.*—White; head, rump and breast, brownish; back, brown and black, streaked; wings, fuscous; bill, yellow,

darker at tip. *Female, in Breeding Plumage*.—Streaked above with black, white below.

Length, about 6.50-7.00; wing, 4.20-4.50; tail, 2.80-3.15.

RANGE.—Northern part of northern hemisphere; south in winter to northern Illinois, northern Indiana and northern Ohio, and southern New England. Casually to District of Columbia, Georgia and Kentucky. Breeds from Labrador to Alaska, north.

Nest, on ground, of grass and moss, lined with fine grass and feathers. *Eggs*, 4-7; greenish or bluish-white, spotted, principally about the larger end, with brown; .91 by .64.

The Snowflake comes to us from the north, in flocks, with the whirling wreaths of the midwinter snow. They are irregular in their coming and variable in their numbers. Sometimes they are absent for several years. Other winters they occur in numbers in the northern portion of the State. Farther south they are of rare occurrence, appearing during the coldest weather.

Dr. Haymond observed it in Franklin County, where it was later identified by Dr. C. R. Case, in December, 1880. Mr. E. L. Guthrie noted it in Decatur County the winter of 1883-4. Mr. Angus Gaines informs me that it is a rare winter visitor in Knox County. Mr. Robert Ridgway has reported a single specimen from Mt. Carmel, Ill., on the opposite side of the Wabash River. They were quite common about Indianapolis during the extreme cold weather and snow of January, 1879 (Brayton).

Mr. J. G. Parker, Jr., says of it, in Cook County, Ill., and Lake County, Ind.: "Not uncommon winter visitor. Found in large flocks on our prairies. On November 9, 1891, I found these birds in thousands on the sand flats about Wolf Lake. December 17, 1895, they were very abundant on the beach at Miller's, Ind. The last leave for the north during March. Latest, March 15, 1884."

Mr. C. E. Aiken says they were exceedingly abundant in the vicinity of Chicago the winter of 1869-70. They were noted in the vicinity of Chicago, November 11, 1895 (Blackwelder), and, the spring of 1893, remained until March 12 (Dunn). At Plymouth, Mich., they appeared October 16, 1894, and in 1893 remained until March 20 (Alexander). They have been noted from Michigan City as a rare winter visitor (Byrkit). Miss Colfax reported them there, January 15, 1884. Away from the lakes we see them very rarely in December, generally appearing in January and February. Among other localities they have been noted as follows: Newton County, seen several times (Pfrimmer); Carroll County, January 15, 1884, January to February, 1885 (Evermann); Starke County, a number of flocks at English Lake, February

14 and 15, 1891; Wabash County, several, winter of 1892-3 (Wallace); Dekalb County (R. W. McBride); Allen County (Stockbridge).

While usually found in flocks of their kind, sometimes small numbers, or single individuals, are sometimes found associated with flocks of Horned Larks, with which at times may be found Lapland Longspurs, also.

With us, they frequent the meadows, pastures, stubble and other cultivated land, living upon seeds of different kinds of grasses and weeds. From examinations made of the stomachs of birds, presumably taken in Wisconsin, their chief food was found to be the seeds of the black bind-weed and foxtail grass (King, Wis. Geology, I. p. 535). "They keep pretty closely in flocks, numbering from a dozen or so to several hundreds, and, though they spread over the ground a good deal in running about after seeds, they fly compactly and wheel all together. In their evolutions they present a pretty sight, and have a not unpleasant strident sound, from the mingling of the weak chirrups from so many throats" (Coues).

125. GENUS *CALCARIUS* BECHSTEIN.

*a*¹. Lower parts whitish; but little white on outer tail feather.

C. lapponicus (Linn.). 206

*a*². Lower parts deep buff; much white on two outer tail feathers.

C. pictus (Swains.). 207

206. (536). *Calcarius lapponicus* (Linn.).

Lapland Longspur.

Adult Male in Summer.—Above, brown, spotted with black; head and jugulum, black, with broad white supra-auricular stripe; lower parts, dull whitish; nape, bright chestnut-rufous; lesser wing coverts, grayish; middle coverts, dusky; legs, black. *In Winter*.—Similar, but throat whitish, jugular patch badly defined, head much tinged with ochraceous, and rufous of nape obscured by grayish. *Adult Female in Summer*.—Head, mostly dull-buffy, the crown with two broad lateral stripes of broad dusky streaks, the ear coverts tipped with dusky bar; a dusky patch on each side of throat, and indication of one on the jugulum; nape, faintly rufous, streaked with black. *In Winter*.—Similar, but more suffused with brownish. *Young*.—Head, neck, jugulum, and upper parts, yellowish-fulvous, streaked with black; crown and wings, strongly tinged with rufous. (Ridgway, Orn. of Ill., Vol. I., p. 241).

Length, about 6.10-6.90; wing, 3.60-3.90.

RANGE.—Northern part of northern hemisphere, in North America; south in winter to Kansas, California, northern Illinois, northern Indiana. Casually to South Carolina, Kentucky, Texas, and North Mexico. Breeds in Arctic regions.

Nest, on ground, in clumps of grass, of grass and moss, lined with feathers. *Eggs*, 4-5; greenish-gray, heavily marked or washed with chocolate; .83 by .60.

The Lapland Longspur ranges farther south than the Snow Bunting. Like it, however, it is found in flocks varying in numbers from a few individuals to several hundred. Often, during their stay with us, they and the Horned Larks are associated in flocks. To the northward, sometimes, but a few Larks will be found in a flock of Longspurs, while farther south, where usually Longspurs are scarce, a few, or even single birds, may be found in flocks of Larks. Their actions, in some respects, are similar.

Dr. Wheaton notes that frequently, when first flushed, they utter a rapid, rattling note, somewhat like that of the Kingfisher, but less loud and harsh. They are irregular in their visits over the most of Indiana, occurring in fall, winter and spring, but are seen more frequently and more numerous than the Snowflake. About the lower end of Lake Michigan they are sometimes seen in great numbers. In the vicinity of Chicago they were exceedingly abundant the winter of 1869-70 (Aiken); also 1895-6 (Blackwelder), and 1896-7 (Tallman). Mr. Parker says it is a common spring and fall migrant in Cook County, Ill. It is found by thousands on the prairies west of Englewood, throughout April, in beautiful spring plumage, and by May 1 most have gone north. Mr. Toppan reports it as a common spring migrant in Lake County, Ind. In Wayne County, Mich., they were seen the winter of 1891-2, and springs of 1892-93-94-95 (Alexander). The earliest fall record from that vicinity is September 26, 1896, and the latest spring date is May 3, 1894. From March 28 to April 4, 1896, they were common, in immense flocks, in fields, accompanied by a few Shorelarks, at Laporte (Barber). Mr. Byrkit had previously reported it from there.

The winter of 1893-4 they were common in Wabash County, arriving in September, and remaining until March 15. Before that there were but two records of its occurrence there. It has been noted as a rare winter visitor in Dekalb County (R. W. McBride); as a regular but rare winter visitor in Allen County; a pair was taken at Ft. Wayne in 1880 (Stockbridge). Dr. J. T. Scovell took three specimens near Terre Haute in the winter of 1881-2. November 14, 1893, Jesse Earlle obtained a single specimen, which he flushed from a wheat

stubble, on bottom land of Big Walnut Creek, Putnam County. Two were taken at Bloomington, February 2, 1883 (Evermann). There is a pair in the State Museum at Indianapolis from Boone County. Mr. Balmer reports it as a winter resident in Knox County, and Mr. Robert Ridgway has noted large flocks at Mt. Carmel, Ill., during severe weather. Mr. E. R. Quick identified it in Franklin County, March 1, 1897, and Mr. V. H. Barnett observed it in Brown County, January 29 and 30, and February 13, 1897.

Mr. B. T. Gault, Glen Ellyn, Ill., says: "June 14, 1889, I took an adult female, in breeding plumage, at Sheffield, Lake County, Ind. When first seen it was flushed from the side of a wagon road, near Lake Michigan, and, taking wing, flew ahead of me but a few feet above the ground. It seemed rather tame, and the probabilities are that it may have been crippled earlier in the season, thus accounting for its late sojourn in this latitude; but, judging from its appearance when skinned, it must have recovered entirely from the effect of wounds previously received (The Auk, Vol. VI., No. 3, p. 278).

While with us its food is wholly the seeds of weeds and grasses. Of six examined by Prof. King, each had eaten more than one hundred seeds of pigeon grass and black bind-weed (Geol. Wis., I., p. 536).

It is common in northern Europe and northern Asia, also breeding in the Arctic portions of those continents, as it does in North America. Mr. E. W. Nelson found it breeding abundantly on the grassy flats near St. Michael's, Alaska. They arrive there early in May, while the ground is still largely covered with snow, and by the middle of that month are common. "The males, as if conscious of their handsome plumage, choose the tops of the only breaks in the monotonous level, which are small, rounded knolls and tussocks. The male utters its song as it flies upward from one of these knolls, and when it reaches the height of ten or fifteen yards, it extends the points of its wings upwards, forming a large V-shaped figure, and floats gently to the ground, uttering, as it slowly sinks, its liquid tones, which fall in tinkling succession upon the ear, and are, perhaps, the sweetest notes that one hears during the entire spring-time of these regions. It is an exquisite jingling melody, having much less power than that of the Bobolink, but with the same general character, and, though shorter, it has even more melody than the song of that well known bird. The nests are placed on the drier portions of the flats; a hummock or tuft of grass is chosen, or perhaps a projecting bunch of dwarf willow stems, and, as one comes directly upon it, the female usually flutters off under one's feet." (N. H. Coll., in Alaska, pp. 184, 185).

207. (537). *Calcarius pictus* (SWAINS.).**Smith's Longspur.****Synonym, PAINTED LONGSPUR.**

Outer tail feathers dusky at base; lower parts, deep buff; legs, yellow.

“Male in Spring.—Top and sides of head, black; a line from bill over the eyes, lores, lower and posterior border of the black cheeks, ears (encircled by black), and a small patch in the nape, white; entire under parts and extending round neck to nape (where it bounds abruptly the black of head), buff or light cinnamon yellow; the under tail coverts, paler; the inside of wings, white; feathers of upper surface, black, edged with yellowish-gray; shoulders or lesser coverts, and the greater, black; middle, white, forming a conspicuous patch; quills, edged externally with white, this involving the whole outer web of outermost primary; whole of outer and most of second tail feathers, white; bill, dusky; lower mandible and legs, yellowish. *Female.*—The markings of male faintly indicated, but the black and buff wanting; head, above, brown, streaked centrally with paler; a narrow dark line on each side of the throat, and brownish streaks across the jugulum, and along sides of body; traces visible of the white marks of the head; bill and feet, as in male.” (Ridgway, Ill., I, p. 243).

Male, length, 6.40-6.50; wing, 3.60-3.70. Female, length, about 5.50-6.00; wing, 3.45-3.60.

RANGE.—Interior plains of North America, east to Indiana, from Texas to Yukon and Mackenzie rivers. Breeds in north part of range. Winters from southern Wisconsin and Kansas, southward.

Nest, on ground, similar to last species. *Eggs*, 4-5; light clay, with spots and lines of dark purplish-brown; size of those of *C. lapponicus*.

Migrant; sometimes common in the vicinity of Lake Michigan; of unusual occurrence elsewhere; rare. Nelson observed this species as a common migrant on the borders of Lake County, Indiana, where even seventy-five were observed in a flock (Brayton, Trans. Ind. Hort. Soc., 1879, p. 121).

In the fall of 1896 a flock of fifty was seen in Cook County, Ill., October 3, and others were seen October 11 (Tallman). Mr. F. M. Woodruff informs me there are four specimens in the collection of the Field Columbian Museum, collected at Worth, Ill., May 3, 1894. At the same place, Mr. J. G. Parker, Jr., found them quite common in a patch of meadow land, April 27, 1893. The spring of 1896 they were first seen near Chicago, April 16, where Mr. Eliot Blackwelder saw

about a hundred, two days later. Mr. C. A. Tallman reported seeing a hundred and fifty. Each of these gentlemen saw them repeatedly that spring, as did also Mr. Parker. They were last noted May 2. March 29, 1894, Mr. Jesse Earle found about sixty Smith's Longspurs in a field about three miles west of Greencastle, Ind. Of these, he obtained two specimens.

Smith's Longspur is a bird of the interior of America, frequenting the great interior plains of the United States and the interior valleys of British America. It breeds in the valleys of the Anderson and Mackenzie rivers very numerous. It is not found breeding on the Atlantic or Pacific coast.

The nest, like that of the last species, is placed on the ground, and is made of grasses, lined with finer materials of the same kind, down and feathers.

126. GENUS POOCÆTES BAIRD.

***208. (540). *Poocætes gramineus* (GMEL.).**

Vesper Sparrow.

Synonyms, BAY-WINGED BUNTING, GRASS FINCH.

Thickly streaked everywhere, above, on sides and across breast; no yellow anywhere; lesser wing coverts, *chestnut*, and one to three outer pairs of tail feathers, partly or wholly white; above, grayish-brown, the streaking, dusky and brown, with grayish-white; below, white, usually buffy-tinged, the streaks very numerous on the fore part and sides; wing coverts and inner quills, much edged and tipped with bay; crown, like back, without median stripe; line over and ring round eye, whitish; feet, pale.

Length, 5.50-6.70; wing, 2.95-3.40; tail, 2.40-2.75.

RANGE.—Eastern North America, west to plains, north to Nova Scotia, Ontario and Manitoba. Breeds from Virginia, Kentucky and Missouri, north. Winters from southern Indiana and Virginia, south.

Nest, in open field, in a depression in the ground, of grass, lined with hair. *Eggs*, 4-5; white, sometimes greenish or pinkish, blotched and lined with various shades of reddish-brown; .80 by .60.

The Vesper Sparrow is found commonly throughout Indiana from March to November. Mr. J. O. Balmer informs me it is also found through winter in Knox County, and doubtless occurs from that latitude south, some winters at least. At Brookville, I have found it as early as February 15, 1882, and until November 19, 1894. Usually, however, they appear near March 20, and, while many leave through

September and early October, quite a number are found until well into the latter month. At Laporte, they were first noted March 20, 1894, April 2, 1896; at Sedan, March 20, 1894, April 4, 1895; Cook County, Ill., April 5, 1886, April 14, 1895. They are usually common over the greater part of the north half of Indiana by the first week in April. I have observed them mating, April 8, 1882. They may be found nesting through May, June and July. July 17, 1886, I took a female Vesper Sparrow, containing eggs about ready to be laid. Two and sometimes, perhaps, three broods are reared in a summer.

The nest is placed upon the ground, preferably in a timothy or clover field; in prairie districts, on the prairie. In September they begin to collect in flocks, and the latter part of the month and all the next they are found along the fence rows, working their way southward.

Prof. King found that 37, which he dissected, had eaten: 8, moths; 3, flies; 3, ants; 27, beetles; 4, grasshoppers; 3, snails; 8, grasshoppers' eggs; 10, larvæ; 31 of them had eaten various small weed seeds; 1, two kernels of wheat, and 1, a kernel of rye. He estimates that fully one-third of their food consists of insects and the remainder largely of seeds of noxious plants (Geol. of Wis., I, p. 536). They remain, sometimes, as far north as our northern border until November. It has been reported from Sandusky, O., November 1, 1896; Sedan, Ind., October 31, 1894; Hillsdale, Mich., November 5, 1894; Livonia, Mich., October 31, 1894.

This striped sparrow shows a white feather on each side of the tail as it flies. That distinguishes it by sight as it flies before one in the public highway, or the field. Its song may be heard in the morning or on cloudy days, but its sweetest notes swell forth at twilight, associated with the sounds of insect life, the glow of the fire-fly, the call of the Whip-poor-will. This is its vesper song; hence its author is known as the Vesper Sparrow. Of all the pretty things said of this sweet-voiced finch, nothing, perhaps, has been said that fits the case so well as that written by Mr. John Burroughs, in his charming book named "Wake Robin." From it I quote: "Have you heard the song of the Field Sparrow? If you have lived in a pastoral country, with broad upland pastures, you could hardly have missed him. Wilson, I believe, calls him the Grass Finch, and was evidently unacquainted with his powers of song. The two white lateral quills of his tail, and his habit of running and skulking a few yards in advance of you, as you walk through the fields, are sufficient to identify him. Not in meadow or orchards, but in high, breezy pasture grounds, will you look for him.

"His song is most noticeable after sundown, when other birds are silent, for which reason he has been aptly called the Vesper Sparrow. The farmer, following his team from the field at dusk, catches his sweetest strain. His song is not so brisk and varied as that of the Song Sparrow, being softer and milder, sweeter and more plaintive. Add the best parts of the lay of the latter to the sweet, vibrating chant of the Woods Sparrow (*Spizella pusilla*), and you have the evening hymn of the Vesper bird, the poet of the plain, unadorned pastures. Go to those broad, smooth, uplying fields, where the cattle and sheep are grazing, and sit down on one of the warm, clean stones, and listen to his song. On every side, near and remote, from out the short grass which the herds are cropping, the strain rises. Two or three long, silver notes of rest and peace, ending in some subdued trills and quavers, constitute each separate song. Often you will catch only one of the bars, the breeze having blown the minor part away. Some unambitious, unconscious melody! It is one of the most characteristic sounds of Nature. The grass, the stones, the stubble, the furrow, the quiet herds, and the warm twilight among the hills, are all subtly expressed in song. This is what they are, at least, capable of."

The song period usually ends near the first of July, though sometimes it may be heard well toward the 1st of August. I heard the last song June 25, 1897.

127. GENUS PASSER BRISSON.

209. (—). *Passer domesticus* (LINN.).

European House Sparrow.

Synonym, ENGLISH SPARROW.

Adult Male.—Above, chestnut brown, back streaked with black; crown, nape and rump, ashy; line back of nostrils, lores and throat, black; remaining lower parts, grayish; chestnut-brown stripe from behind the eye to the back; wing, edged with brown; cheek, sides of neck and bar across the wing, white. *Female*.—Lacking the black on head and neck; lower parts and cheeks, ashy; breast and abdomen, tinged with reddish; head and rump, grayish; back, streaked with black; stripe over the eye, and wing bar, ochraceous.

Length, 6.00; wing, 2.85; tail, 2.50.

RANGE.—Almost all Europe, western Asia; introduced into North America, Australia and other countries. Now occupying the eastern United States and southern Canada, and extending west to Colorado, and Utah. Not so numerous in Southern States.

Nest, about houses, in trees, etc., of grass, hay, and feathers. *Eggs*, 6-9; soiled white, speckled with brown; .86 by .62.

The European House Sparrow, which is generally known as "English Sparrow," is a resident throughout the State. Its history in America is but one of the accounts of the folly of ignorance, in the introduction of species into a new country, where, under favorable conditions, they so thrive at the expense of man and his native bird



European House Sparrow. Male.

(Barrows, Bulletin I, Division of Economic Ornithology and Mammalogy, United States Department of Agriculture, 1889, p. 16.)

friends, that they become a serious pest. They were first introduced into the United States at Brooklyn, N. Y., in 1850, and into several other cities at different times from that date to 1869. They were brought to Louisville, Ky., between 1865 and 1870. Cleveland, O., received 40 birds in 1869, and the same year Cincinnati received 66 pairs. In Indiana, they are said to have first appeared at New Albany, presumably from Louisville, Ky., in 1867. In 1869 they were brought to Richmond from Philadelphia, Pa. In 1871 and 1872 several hundred were brought to Indianapolis from New York City. In 1873 they were introduced into Evansville, and about 1874 into Lafayette. From these points they spread, appearing at Burlington about 1870; Greencastle, 1872; Bloomington, 1875, and at Brookville, 1878. It was not observed at Albion until about 1880.

It is now to be found in suitable localities in every part of the State. At the close of the year 1886 it was to be found in 35 States and 5 Territories. It has spread very rapidly, reaching west to central Kansas and Nebraska. From there it followed the railway lines, reaching Pueblo, Col., in 1895, and Denver in the summer of 1896. In March, 1897, it was estimated that less than twenty pairs were to be found in the latter city (Cooke, *Birds of Colorado*, pp. 99, 100).

They have proved their enmity to our very best native birds, have lived off the farmers' crops, ruthlessly destroyed fruits and vegetables, and, by reason of their noisy chatter, their dirtiness, and other undesirable habits, have made themselves public nuisances. In Indiana, they have occupied many of the nesting sites of the Martin and Bluebird. From many towns and farms the latter have almost disappeared. The Chipping Sparrow, Robin, House Wrens, and Carolina Wrens, and even the Great Crested Flycatcher and Red-winged Blackbird, have been persecuted by them. The United States Department of Agriculture has had specific reports from all parts of the United States of 70 kinds of native birds it has molested. Of 1,860 complaints received regarding molested birds, more than one-half relate to Martins, Swallows, Wrens, and Bluebirds. In the garden they are most destructive to young peas, and in the field, to ripened wheat. As soon as the tender pea sprouts are out of the ground, it is not uncommon for a number of these sparrows to begin at some point in the row and bite off the leaves from every vine, completely destroying the crop. When wheat is ripe, young and old are associated in flocks. They leave town and village for wheat fields, and, breaking down the stalks, feed upon the grain until it is shocked. Then I have known them to eat all accessible grains in the cap, and outside sheaves, and, when the crop was stacked, to live upon the stack until it was threshed and garnered. They also eat oats, barley, rye, and corn. Besides these, reports from this State indicate they eat lettuce, cabbage, radish, and beets, particularly the young plants, also their seeds. In the spring they cut off apple blossoms, and later, sometimes eat mellow apples, and juicy pears. They also eat cherries, currants and strawberries. In Indiana, I have found them, of all fruits, to destroy grapes the most. This I find has also been the experience of others.

The fall of 1896 they began work upon my grapes about August 20. The Delawares were first attacked. Early in the morning they commenced cutting off the bunches, then gathering upon the ground to eat the fallen fruit. Many also ate grapes from such bunches as they could reach from a perch. The next grapes attacked were the Prentiss, following which came the Catawba. There were other kinds, but they did

not suffer perceptibly. For about ten weeks ending about October 25 a great part of their food was grapes. The insects they destroy are comparatively few, and are most often caught to feed the young. I have occasionally seen a Sparrow catch a moth or other flying species, and on one or two occasions have observed them hunting among cabbage heads, as though they were after cabbage-worms. Indeed, they are known to occasionally eat these. July 21 a mass of larvæ of a species of ant was found associated together and so arranged that they looked like one large worm the size of a piece of rope. They were upon a street crossing in Brookville. All moved together in one direction. A few specimens were taken and sent to Mr. L. O. Howard, U. S. Entomologist, Washington, D. C., for identification. Soon after a flock of House Sparrows found this living rope, and ate it all. The mass was about $1\frac{1}{2}$ feet long, $\frac{3}{4}$ inch wide and $\frac{1}{2}$ inch deep.

The following is a summary of the contents of 522 stomachs of these birds, examined by the United States Department of Agriculture: "Wheat was found in 22 stomachs, oats in 327, corn (maize) in 71, fruit seed (mainly mulberries) in 57, grass seed in 102, weed seed in 85, undetermined vegetable matter in 219, bread, rice, etc., in 19; noxious insects in 47, beneficial insects in 50, insects of no economic importance in 31. Doubtless most of the oats found in the stomachs were obtained from horse droppings, and some of the undetermined vegetable matter was from the same source." Insects constituted but a little over 17 per cent., which, when we consider that it was an unusually favorable year for insects at Washington, D. C., where most of these birds were killed, and, further, that the grounds where they were taken were infested with several noxious forms, of which only two specimens of one kind were found to have been eaten by the sparrows, is not favorable to this bird as an insect destroyer.

They are very prolific. I have found them mating January 16, 1887, and have found young barely able to fly July 30, 1896. They sometimes lay in February and, perhaps, rarely breed as late as November. I have found nests with from three to nine eggs. It is supposed they lay from four to six sittings a year, and it is estimated that each pair raised 24 young in a season. The rate of increase is enormous. How shall it be held in check? In most States it is outlawed; some States have offered a bounty for its capture, but the results have not been altogether satisfactory. Poisoning has been tried, generally with unsatisfactory results. Trapping, too, has been used. It is said Mr. W. T. Hill, of Indianapolis, trapped 40,000 of them in Indianapolis the two years ending October 1, 1887. Outside the immediate neighborhood of operations no effect was observed. The best thing to do is to

wage war upon them with gun, trap, poison, and every other way that will work. I find that the best results are obtained by destroying the eggs, and using a gun on the adults. But to our help comes natural causes. Some hard winters many of them perish. In Wabash County, and perhaps elsewhere, a great many were destroyed the winter of 1892-3 (Ulrey and Wallace, Proc. I. A. S., 1895, p. 154). Cats are efficient aids. I am satisfied the greater part of my grapes were saved in 1897 by a cat which spent hours among the vines and on top the arbors. Several birds have become more useful by their destruction of this sparrow. Shrikes, Blue Jays, and Bronzed Grackles are mentioned, but sometimes in the country and borders of towns the Sparrow Hawk, Sharp-shinned and Cooper's Hawks, Marsh Hawk, Red-shouldered Hawk, the Short-eared Owl, and occasionally the more rare Pigeon Hawk, eat them. In towns and cities, as well as country, the Screech Owl is a valuable destructive agent. It, and the Sparrow Hawk, especially, should be protected. The House Sparrow is also subject to accidents, and, doubtless, to disease. Prof. C. A. Waldo informs me a few years ago, at Greencastle, Ind., of seeing a Sparrow suspended from a building by a string about its neck, while about it was a noisy crowd of its fellows, flying at it and pecking it.

His query was, whether it committed suicide, was hanged by its fellow-outlaws, or accidentally came to such a fate (See Report of Orn. and Mam., U. S. Dept. Agr., Report 1886; also, same Dept., Bulletin No. 1; also, Walter B. Barrows, "The English Sparrow in America," etc., 1889, from which some of the above data is derived).

123. GENUS AMMODRAMUS SWAINSON.

*a*¹. Outer pair of tail feathers longer than the middle pair; wing much longer than tail. Subgenus *PASSERCULUS* Bonaparte.

A. sandwichensis savanna (Wils.). 210

*a*². Outer pair of tail feathers shorter than the middle pair; wing not much, if any, longer than tail.

*b*¹. Bill stout; tail feathers narrow and sharp-pointed; center of crown with a light stripe. Subgenus *COTURNICULUS* Bonaparte.

*c*¹. Tail much shorter than wing; double rounded.

A. savannarum passerinus (Wils.). 211

*c*². Tail about equal to or longer than wing; outer tail feathers shortest.

*d*¹. Bill very stout; a dusky streak on each side of the light malar stripe.

A. henslowii (Aud.). 212

*d*². Bill very small and slender; no dusky streak on each side of the light malar stripe.

A. leconteii (Aud.). 213

*b*². Bill slender; tail feathers sharp pointed; outer ones shortest; center of crown without a light stripe. Subgenus *AMMODRAMUS*.

A. caudacutus nelsoni Allen. 214

Subgenus *PASSERCULUS* Bonaparte.**210. (542a). *Ammodramus sandwichensis savanna* (Wils.).****Savanna Sparrow.**

Above, brownish-gray, streaked with blackish, whitish-gray and pale bay; the streaks largest on the inner scapulars, smallest on the cervix; the crown divided by an obscure whitish line; superciliary line and edge of wing, yellowish; sometimes an obscure yellowish suffusion about the head; below, white, pure, or with faint buffy shade, thickly streaked with dusky, the individual spots edged with brown, mostly arrow-shaped, running in chains along the sides and often aggregated in an obscure blotch on the breast; wings and tail, dusky; the wing-coverts and inner secondaries, black, edged and tipped with bay.

Length, about 4.85-5.50; wing, 2.60-2.90 (2.73); tail, 1.90-2.20 (2.07).

RANGE.—Eastern North America, from Mexico and Cuba to Labrador and Hudson Bay. Breeds from Missouri, southern Illinois and New Jersey north. Winters from Indiana and Virginia southward.

Nest, in depression on ground; of grass. *Eggs*, 3-6; greenish or grayish-white, spotted and blotched most thickly about the larger end with light-brown and lilac; .76 by .54.

The Savanna Sparrow is, some seasons at least, a rare resident in the lower Wabash Valley. Mr. J. A. Balmer in 1888 noted it as a winter resident in Knox County, and Mr. Robert Ridgway at that season across the Wabash River at Mt. Carmel, Ill., where he also has taken its nest and eggs. The bulk of these Sparrows pass northward with us through April. At Brookville they are often found in flocks, frequenting the pastures, meadows and stubble of the upland farms. In the river valleys they are rare. All I have ever seen in the spring have been between April 9, 1887, and April 24 (1886).

They are inconspicuous, and will often be overlooked, as they run or crawl among the grass and weeds, unless when too closely pressed, they rise but a little piece above the ground and all fly away to another field. In 1897 it was seen at Richmond, March 26 and April 29 (Hadley). In 1892, at Bloomington, March 30 (Kindle); at Terre Haute, May 1, 1890 (Evermann); Spearsville, May 3, 1894 (Barnett). They were first noted in Cook County, Ill., in 1896, March 31; in 1895, April 1; in 1897, April 8 (Fallman). While many of them leave early in May, they are often common after the middle of that month; May 18, 1895; May 23, 1896. Mr. J. G. Parker, Jr., thinks it breeds not uncommonly about Calumet Lake, where he collected one July 16,

1896, and another August 4, 1896. May 30, 1894, he found it common about Wolf Lake. "In northern Illinois, in Wisconsin and Minnesota it is in some localities common, breeding in large colonies, but in other entirely similar places it is not found at all" (Nehrling, N. A. B., Pt. X., p. 84). There is a specimen in the State Museum at Indianapolis that was taken at English Lake, Ind., June 14, 1896. Dr. J. M. Wheaton notes he once observed it in Ohio in June, and refers to its breeding at Gambier (Birds of Ohio, p. 325).

In the fall they begin to be observed migrating in September. The earliest record I have at Brookville is September 9, 1886. They may be seen through that month and the next. The latest record I have from Cook County, Ill., is October 11, 1896. Some, however, linger along into November, and stop with us in mild winters. The song is always a weak affair, as easy to be overlooked as the singer. At breeding time insects are eaten; at other times they do good by destroying great quantities of weed seed (King, Geol. of Wis., I., p. 536).

Subgenus *COTURNICULUS* Bonaparte.

***211. (546). *Ammodramus savannarum passerinus* (WILS.).**

Grasshopper Sparrow.

SYNONYMS, CRICKET SPARROW, YELLOW-WINGED SPARROW.

Adult.—Above, chestnut-brown, edged with ashy, streaked with black; nape, grayish or buffy, with small chestnut spots; lower back and rump, reddish and ashy; head, throat, breast and sides, ochraceous-buff; other under parts, whitish; edge of wing and spot before the eye, yellow; no streaks on side of breast; crown, blackish, with a middle stripe over the eye of buff or paler gray; tail feathers, narrow and pointed; they, and wing feathers, edged more or less with whitish. *Immature*.—More buffy below; grayer above; breast, streaked with dusky.

Length, 5.20; wing, 2.50; tail, 1.90; bill, .50; depth of bill, .25; tarsus, .80.

RANGE.—Eastern North America, from Costa Rica and West Indies; north to Dakota, south Ontario and Massachusetts; casual in Maine. Breeds throughout United States range. Winters from southern Illinois and North Carolina southward.

Nest, on ground; of grass. *Eggs*, 3-5; white, spotted and blotched with reddish-brown; .73 by .58.

Over most of Indiana a common summer resident, frequenting timothy and clover meadows, prairies and fields of small grain. In the three first mentioned its nest-building is upon the ground. Sometimes,

at least, two broods are reared in a season. Davie reports fresh eggs having been found in Illinois as late as August 12. I have observed young not able to fly, at Brookville, Ind., July 8, 1887. They have been gradually increasing in numbers and extending their range. Fifteen years ago, in the lower Whitewater Valley, they were rare, anywhere; now, it is the most common meadow bird on the uplands, but it is rare in the lowlands. In 1886 it was a rather common summer resident in Monroe County and a very rare summer resident in Carroll County (Evermann). It was not reported at that time from Putnam or Lake counties, where there were good observers. Although Mr. Nelson gave it as abundant in Cook County, 1876, Mr. H. K. Coale collected there and in Lake County for a number of years up to about 1888, and was unable to find it. In May, 1887, I visited many localities in Cook County and failed to observe it. It first began to be common in Dekalb County in 1893, and Prof. A. J. Cook notes its increasing abundance in southern Michigan (Birds of Mich., p. 112).

The following are the earliest and latest dates of first arrival in spring: Brookville, April 8, 1892, April 27, 1885 and 1897; Chicago, Ill., April 18, 1896, May 11, 1895; Waterloo, April 21, 1896; Plymouth, Mich., April 19, 1896; Petersburg, Mich., April 23, 1897.

Often when they arrive in the spring they are mated. One who is familiar with them will first detect their arrival by their peculiar stridulating song. It reminds one of the music made by the grasshopper or cricket. From this curious song the bird is named. The song has several variations, among which are the following: "pit-tick-zee-e-e-e-tick," or, "tick-zee-e-e-e-c;" another, the most common of the longer efforts, is, "pit-tick-ze-z-rr (trill) l-rl (rl sometimes three or four times repeated) ee-e-e." It may be sung from the ground, a weed in the meadow, a small bush, a clod in a plowed field, or a fence-post. It begins with the dawn, and may be heard through the day and until 8 or 9 o'clock at night. A favorite position is on a fence, where they will often permit one in a buggy to pass within 10 or 15 feet of them. Then the large bill and head, short tail and wings and light-colored legs, may be plainly seen. When they have selected a home they seldom fly far, but when they first arrive, or after breeding is past, they make long, zigzag flights close to the ground.

The sudden changes which come to their homes are enough to drive these birds away, and that is generally the result. Late in June they are driven from the fields of small clover when the first crop is mowed. Then they seek other fields for a short time, until the abundant rains cause it to renew its growth. By the middle of July the mower cuts clean the fields of timothy. About the meadows the fences

are full of these little Sparrows in full song. Some find cover in the fields of English clover, or wheat stubble. The greater number, however, leave at this time. This occurred in 1897, July 14. I found them still common in fields of English clover August 3, 1897, and the last were noted August 6, still singing. About that time cutting of the large clover began, and they disappeared. Some years a few remain later than this, but they quit singing, and skulk along the grassy and weedy fence rows, and are hard to find. In 1894 I found them as late as September 25, and that same year they remained at Sedan until October 20 (Mrs. Hine). Mr. V. H. Barnett reported it at Trafalgar, Brown County, October 23, 1897.

***212. (547). *Ammodramus henslowii* (AUD.).**

Henslow's Sparrow.

Adult.—Tail feathers, narrow, sharp-pointed, outer ones much the shortest, middle ones bright rufous-brown, darker along the shafts; others darker, edged with ashy; bill, large; crown, blackish, divided by a middle stripe of pale olive-green; stripe over eye and sides of head and nape, pale olive-green, which also tinges the back; a black stripe behind the eye, and one from the corner of the mouth, and usually one, more or less distinct, on each side of upper throat; back, brown, the feathers marked with black and edged with grayish; tertiaries and rump, chestnut-brown, more or less grayish edged. Below, whitish, more or less shaded with buffy; breast and sides streaked with black (wanting in young). Edge of wing, yellow.

Length, 4.75-5.25; wing, 2.10-2.20; tail, 1.90-2.05.

RANGE.—Eastern United States. Breeding locally from Maine, Virginia north to Nebraska, northern Indiana and Michigan. Winters from Illinois south to Gulf of Mexico.

Nest, in meadow, prairies or neglected fields; on ground in tuft of grass; of dry grass and hair. *Eggs*, 4-5; greenish or grayish white, speckled and blotched with different shades of brown and lilac; .75 by .57.

Although Henslow's Sparrow has never been taken in southern Indiana it probably occurs as a migrant, but is overlooked because it is not readily recognized. Audubon drew his description and figure from a bird of this species taken at Newport, Ky., across the river from Cincinnati, O. In the northern portion of the State in the wet prairies and marshes, they breed in companies in certain localities. The first record I have from this State is a specimen taken by Mr. C.

E. Aiken while hunting Prairie Chickens in Lake County, in August, 1869. He identified it, but did not preserve it. Near Tolleston, in the same county, Mr. H. K. Coale obtained a male May 10, 1877. He says: "Hearing a rustle in the grass, I looked down and saw a bird, which ran like a mouse. It stuck its head under some leaves and grass, leaving its tail exposed. I had to go back some distance to shoot it."

July 4, 1881, he visited the same locality again and found quite a number of these birds confined to a restricted area. He obtained five specimens. The males were in full song, and he is confident they were breeding. Mr. J. G. Parker, Jr., collected a female, near Liverpool, Ind., May 18, 1895, and a pair July 4, 1896. He had previously taken several west of Cheltenham Beach, Cook County, Ill., April 29, 1886. He says the bird is loth to take wing from its shelter of weeds and grasses, and when it does fly it goes but a short distance, and just above the tops of the weeds, again alighting and skulking like a field mouse.

Two males were collected at English Lake, June, 29, 1891. Mr. Ruthven Deane informs me that he spent July 26, 1891, making the acquaintance of that species at the same locality. He reported seeing about twenty-five specimens, of which two persons killed ten. They were very shy and hard to collect, and had been there all summer; Mr. Deane also observed them the latter part of June, 1894. Within five days after receiving Mr. Deane's account of his first trip, my friend, Mr. Chas. Dury, of Cincinnati, O., wrote me that two of his friends had visited English Lake in July and August. They found Henslow's Sparrows rather common and breeding, and took some specimens, including some young birds. An adult taken there was kindly presented to me by Mr. Ralph Kellogg, one of the collectors. Mr. J. O. Dunn informs me Henslow's Sparrows were very common in a field of weeds near the southeast corner of Bass (Old Cedar) Lake, Starke County, Ind., late in July, 1894. They were apparently breeding, but no nests were found; two males were taken. One beautiful evening, about 10:30 o'clock, a bird of this species was heard singing near camp. July 24, 1895, the same gentleman, with Mr. Wallace Craig, found it abundant in an extensive field of tall weeds near Wilders. Ind. Mr. Dunn says of his experience with them there, in "The Auk," Vol. XII., October, 1895: "Henslow's Sparrows seem to be quite numerous and found over a considerable area in the prairies. They sing frequently, and may be found in almost, if not quite, the hottest part of the day. The song is very simple, being a very rude attempt at producing music. It consists,

as far as I have been able to determine, of two insect-like notes; it may be represented by the syllables, *stitch*, *lick*, uttered in quick succession, and once, when I had fired several shots without hitting anything, I thought the bird said, "Such luck, such luck." The notes, as has been said, are insect-like in character, especially the first one, which is very lisping, the last note having more volume. The notes are not loud, but may be heard at some distance, and are somewhat ventriloquistic, seeming to come from some general direction, but not from any definite spot, so that it is impossible to locate the birds easily by their notes." Mr. Nehrling, N. A. Birds, Pt. X., p. 88, gives its song as, "Sit-sit-sit-sit-ser-it." Lynds Jones says: "The song is a few short and rapidly-uttered notes, something like, 'i-tse, tse-tsip.'" Mr. L. Whitney Watkins, May 12, 1894, added this species to the Michigan list, and May 30 found a nest containing five eggs in Jackson County, Mich. June 8 the female was shot as she was leaving the nest, and identified. The nest was in an open marsh, bordering a lake. It was placed in a tuft of grass about four inches above the wet ground, and is neatly, though loosely, constructed of coarse grasses and sedges, lined with finer ones. The eggs average .72 by .59 inches, and are white, with small reddish specks so numerous as to form an imperfect wreath about the large end. Incubation was well advanced. The nest was hardly different from one of a Maryland Yellow-throat, found on the same day in the same locality (Proc., I. A. S., 1894, p. 74). Mr. James B. Purdy more recently has recorded taking a bird and the nest and eggs at Plymouth, Mich., July 27, 1893 ("The Auk," Vol. XIV., 1897, p. 220).

Mr. Eliot Blackwelder noted five of these birds in Cook County, Ill., April 16, 1896. Mr. W. O. Wallace took a male in a cherry orchard at Wabash, Ind., April 26, 1897. Mr. Robert Ridgway found it exceedingly numerous during the latter part of October, 1882, in dead grass in the damp portions of meadows in Richland County, Ill. (B. of Ill., I., p. 255). It therefore arrives from April 16 to May 10 and remains until late in October. Prof. W. W. Cooke says it sometimes winters in southern Illinois (Report Bird Mig. Miss. Valley, p. 191).

213. (548). *Ammodramus leconteii* (AUD.).

LeConte's Sparrow.

Adult.—Tail feathers, narrow, sharp-pointed, the outer ones much the shortest, light-brown, shaded with grayish, centers very dark; bill, small; culmen, slightly depressed in the middle; crown, black, feathers sometimes bordered with brown, divided by a middle stripe of whitish

or cream; stripe over the eye, buff; a black stripe behind the eye; nape, reddish-brown, feathers with black centers and whitish edges; back and rest of upper parts, black, feathers edged and bordered with different shades of brown and buff and whitish; ear-coverts and lores, grayish-white. Below, whitish; breast, throat and sides, washed with buffy; sides, streaked with black. *Immature*.—Similar, but more buffy.

Length, 4.40-5.50; wing, 1.87-2.06; tail, 1.87-2.25; bill, .35.

RANGE.—Eastern portion of the Great Plains, north to Manitoba. Breeds from Dakota and, possibly, Iowa, north. Migrates south and southeast. Winters from Illinois, South Carolina and Texas, south to the Gulf of Mexico.

See description of nest and eggs below.

LeConte's Sparrow is only known from Indiana as a rare migrant in March, April and October. March 12, 1884, I found a bird which I could not identify at close range, sitting on a small bush near the railroad track, four miles northwest of Brookville. Backing, so as not to destroy it, I shot it, and it is now in my collection. I am indebted to Mr. C. E. Aiken for the following note, from Lake County, Ind.: "While snipe shooting near Water Valley about April 15, 1887, I caught sight of two small, yellowish Sparrows darting out of the dead lopping flags of the marsh. I believed them to be this species, but could not secure them for close examination. At about the same season in 1889, in the same vicinity and on similar ground, I started three of the same birds, and as they scurried off I shot two of them, which proved to be, indeed, *A. leconteii*, one a male, the other a female. Both specimens are preserved, and one is still in my possession. The other was given to my friend, C. H. Holden, of Chicago. When flushed, the birds started from thick cover close to me, flew straight away from five to twenty rods, then darted again into the dead marsh grass or rushes, from which I could not start them a second time. The rise was not more than two feet above the grass, except in one case, that of one of the birds killed, which had apparently started for a long flight and was flying about four feet above the ground when shot. I did not see any of them except while on the wing."

March 30, 1892, Mr. J. E. Beasley took a bird of this species, which was with two or three others, possibly of the same kind, feeding among the dead grass by the side of the railroad, near Lebanon. This specimen, a male, is now in the State Museum at Indianapolis. October 2, 1894, I saw a LeConte's Sparrow along the edge of a clover patch near Brookville. Besides these records from Indiana, I may say Mr. Eliot Blackwelder noted six at Morgan Park, Ill., April 21, 1895.

They were next seen the following day, and a few days later four were taken. The same authority reports them April 16 and 19, 1896, from the same vicinity. Mr. Robert Ridgway says the latter part of October, 1882, he found it numerous in the meadows of Sugar Creek Prairie, Richland County, Ill., in company with the species last mentioned (Birds of Ill., I., pp. 257, 258).

Mr. Ernest E. Thompson says of Leconte's Sparrow, in its summer home in Manitoba: "This bird frequents the damp meadows, which are a mixture of red willows and sedgy-grass. It is commonly found in the willows at all seasons, uttering its peculiar ventriloquial tweete, tweete, whence I knew it as the 'Willow Tweete' long before I ever heard of Leconte or any other name for this bird. But in spring the male may be seen perched on some low twig in the meadow, pouring out its little soul in a tiny, husky double note, like 'reese-reese.' This is so thin and so weak as to be inaudible at thirty yards, yet in uttering it he seems to labor hard, his beak being wide open and pointed straight up to the zenith; he delivers it with such unction that afterwards he seems quite exhausted, and sits very still until at length the fit comes on again, as it is sure to do in about ten seconds.

"On the 26th of June, 1882, I found the nest and eggs, which, I believe, were previously unknown. The nest was by a willow bush in a damp meadow; it was apparently on the ground, but really raised six inches, being on a tangle of grass, etc. It was composed entirely of fine grass. The eggs—three in number—were of a delicate pink, with a few spots of brownish and of black toward the large end. The pink was lost on blowing them. One measured .75 by .50 inches" (The Auk, Vol. II., January, 1885, pp. 23, 24; see also Proc. U. S. Nat. Mus., Vol. XIII., p. 596). Prof. W. W. Cooke says it winters and possibly breeds in Illinois (Bird Mig. Miss. Valley, p. 191).

Subgenus *AMMODRAMUS*.

214. (549a). *Ammodramus caudacutus nelsoni* ALLEN.

Nelson's Sparrow.

Tail feathers, narrow and sharp-pointed; outer ones much the shortest, umber-brown, darkest along the shafts; bill, not large; crown, olive-brown, divided by a middle stripe of blue-gray; breast, sides, throat, a stripe over the eye and sides of head, excepting grayish ear-coverts, deep ochraceous; back, brown or olive-brown, feathers margined with whitish; tertials, dusky, bordered with rusty white or rusty. Below, belly white; the ochraceous breast, throat and sides, faintly, or not at all, streaked with dusky; edge of wing, yellow.

Length, 4.80-5.85; wing, 2.12-2.23; tail, 1.90-2.25; bill, .53-.59.

RANGE.—Eastern United States. Breeds in interior locally from northern Illinois north to Manitoba. Winters from South Carolina to Texas. Found along the Atlantic Coast from Massachusetts south during migration.

Nest and eggs, unknown; probably similar to those of *A. caudacutus*.

Migrant and possibly a summer resident locally in the northwestern part of the State where, only, it has been observed within our limits. Nelson's Sparrow was discovered by Mr. E. W. Nelson in the Calumet marsh, near Chicago, Ill., September 17, 1874. They were then abundant there. June 12, 1875, he found several of these birds in the dense grass bordering Calumet Lake, where they were undoubtedly breeding. October 1, next, they were abundant in the Calumet marsh, and November 10 following they were numerous in the wild rice bordering Grass Lake, Lake County, Ill. (Bull. Essex Inst., Vol. VIII., 1876, p. 107).

Mr. H. K. Coale informs me that he saw about a dozen Sharp-tail Finches, *A. nelsoni*, in the grass along Berry Lake, Lake County, Ind., September 25, 1875. Dr. A. W. Brayton informed me he had taken this species in Lake County, Ind. These are the only two Indiana records.

Mr. J. G. Parker, Jr., considers it now very rare in Cook County, Ill., where he thinks it probably breeds. The only locality where he has found it is on the wet prairies bordering the east shore of Calumet Lake. There he collected two birds September 19, 1893. Mr. Eliot Blackwelder, however, reports it from the vicinity of Morgan Park, September 28, 1895, where he says it is not common and breeds. I have a specimen from Hyde Park, Ill., taken September 21, 1878, about which time Mr. G. F. Clingman took five specimens in a week at Mud Lake.

Mr. Nelson says: "They are difficult to obtain, as they take refuge in the dense marsh grass upon the first alarm. Occasionally one mounts a tall reed and utters a short, unmusical song, slightly resembling that of the Swamp Sparrow (*M. palustris*).” Mr. Nehrling says: "In northern Illinois and near Lake Koshkonong and in the Horicon marshes in Wisconsin this is an abundant summer resident" (N. A. Birds, Pt. X., p. 92). It appears to be extremely local in its distribution in the breeding season.

129. GENUS CHONDESTES SWAINSON.

215. (552). *Chondestes grammacus* (SAY.).*Lark Sparrow.**

Adult.—Crown, chestnut, black towards forehead, divided by a middle stripe of whitish; stripe over eye, one from the angle of the mouth, meeting it behind the ear-coverts, and a crescent below the eye, whitish; a black stripe through and one below the eye, and one on each side of the throat; ear-coverts, chestnut; remainder of upper parts, pale grayish-olive, the back with blackish markings. Below, white; a small black spot in the middle of the breast; tail, rounded; outer tail feathers



Head of Lark Sparrow. Natural size.

edged with white; others, except the middle pair, tipped with white, which the bird shows as it flies with the tail partly spread. *Immature.*—More buffy; chest streaked with dusky.

Length, 6.50-7.25; wing, 3.35-3.70; tail, 2.60-3.35.

RANGE.—Interior of North America, north to Manitoba and from Ohio, Indiana and Ontario west to the plains. Breeds throughout its range. Accidental on Atlantic Coast north to Massachusetts. Winters from Texas south.

Nest, of grass, rootlets and hair; on the ground or in low bushes. *Eggs*, 3-5; white, bluish or pinkish-white, speckled and lined chiefly at the larger end with black and dark-brown; .80 by .61.

The Lark Sparrow is a prairie species that is year by year extending its way into the former forest area. In 1861 it made its first appearance in Ohio, and about the same time appeared in Ontario. In 1879 it was common throughout central Ohio, but both north and south of there it was rare. In Indiana it is most numerous through the central part of the State. It was rather rare until recently in southern Indiana, and is still scarce in many localities northward. Everywhere

it is apparently becoming more numerous. They first appeared in Franklin County about 1877. They were rare in Monroe County in 1886 and in Carroll County that year they were noted as "until recently very rare" (Evermann). In 1871 they were rare in Lake County (Aiken), and are still reported as rare in Dekalb (Mrs. Hine) and in Cook County, Ill. (Tallman, Parker).

In the southern part of the State they may be found in pairs or small flocks from April 15 to May 10, and in the northern part they are noted from April 25 to May 12. The following are the earliest and latest dates of its first arrival in spring at the places mentioned: Spearsville, April 11, 1897, April 18, 1894; Brookville, April 18, 1885, May 11, 1882; Elkhart, April 23, 1891; Cook County, Ill., May 9, 1896, May 12, 1894; Petersburg, Mich., April 26, 1897, May 5, 1888. With us, when they arrive, they are first seen upon the sandy fields and weedy and grassy bottom lands along the rivers. Later, they frequent open fields having fence rows grown up with bushes or adjoining sparse woodland; also, the neighborhood of shady highways, along which they spend the sunny days, and from which they enjoy the pleasures of a dust bath. They are readily recognized as they fly up ahead of the passing traveler, and exhibit their decided markings and rounded tail, each feather so beautifully tipped with white. I find them mating early in May. May 3, 1881, is the earliest date, and that was the date of their first arrival that year. With us, the nests are placed in bushes, in a thicket or along a fence. It is also said to nest at the foot of some weeds on the bare ground (Nelson), and in cornfields, where the nest is put at the foot of a cornstalk (Ridgway). They begin nesting in May and continue well through June. Mr. V. H. Barnett found a nest at Spearsville, June 18, 1897. June 10, 1897, I found young able to fly near Brookville. I found four pairs of these birds nesting along a public highway near Brookville that year in a distance of less than a mile. They have a beautiful song, in some respects reminding one of the Indigo Bird's notes.

After the young are reared, most of the birds leave through July and August. Sometimes they collect in considerable flocks. One that Mrs. Hine observed near Sedan, August 16, 1887, contained about fifty birds, and Mr. V. H. Barnett saw one August 4, 1897, in Vermilion County containing twelve. Some, however, are found in September, October and even November. The following are the latest dates of its fall occurrence: Plymouth, Mich., September 15, 1894; Sedan, Ind., September 15, 1892; Lafayette, October 13, 1885, November 3, 1894; Greensburg, October 29, 1894.

Mr. H. K. Coale says in some parts of Illinois it is called the "Potato Bird," because of its eating potato bugs. But few survive the paris green which they eat with the bugs. In May and June Prof. King found those he examined had eaten nothing but small seeds (Geol. of Wis., I., p. 540).

130. GENUS ZONOTRICHIA SWAINSON.

*a*¹. No yellow anywhere; throat not abruptly white.

Z. leucophrys (Forst.). 216

*a*². Yellow on head; throat abruptly white.

Z. albicollis (Gmel.). 217

216. (554). *Zonotrichia leucophrys* (FORST.).

White-crowned Sparrow.

Adult.—No yellow in front of eye; throat, ashy; edge of wing, white; crown, white, bordered by two black stripes, each as wide as the white center; a black stripe behind each eye almost meeting on back of head; white stripe from over eye to back of crown; nape and sides of head, gray; back, light ash-gray, streaked with chestnut-brown; rump, brownish; wing-coverts, edged with chestnut and tipped with white, forming two white bars; tail, fuscous. Below, grayish, white on belly; sides and lower tail-coverts, buffy. *Immature*.—Black stripes on the crown, brownish; white stripe, brownish-yellow or ashy.

Length, 6.50-7.50; wing, 3.00-3.30; tail, 2.80-3.20.

RANGE.—North America, from Mexico north at least to Hudson Bay and Greenland. Breeds from Labrador, Vermont and Wisconsin to Rocky Mountains and northward; also, south in the higher mountain ranges of the western United States to Colorado and California. Winters from southern Indiana and southern Illinois south.

Nest, bulky; of grass or straw; on ground or in bushes or briers. *Eggs*, 4-5; light green or greenish-blue, tolerably uniformly speckled with small blotches of reddish and golden-brown; more prominent at the larger end; .88 by .62.

Common migrant; occasional winter resident southward. Very noticeable late in April and early in May. I always associate this beautiful bird with the fragrance of apple blossoms, for they come together. At the time of the spring migration they are usually found singly in gardens, orchards and occasionally in the more open woods. Then its characteristic song declares its presence. This song, Mr. Nehrling says, sounds like, *pee-dee-de-de-de*. The first two notes are long drawn and rising, the rest hurried and lowering, the whole sounding like a mellow whistle, being easily imitated. It is easily distinguished from that of the White-throated Sparrow. The White-crown

arrives later in spring than the White-throat, yet the former sometimes winters in southern Indiana, while the latter, so far as I know, has not been noted. The White-throat thus passes it in migration. In winter the present species frequents swampy woods and thickets. Some remained in Knox County the winter of 1888-9 (Balmer), and the winter of 1896-7 (Chansler). Mr. Robert Ridgway reports them often wintering abundantly at Mt. Carmel, Ill., and Mr. Charles Dury found them at Cincinnati, Christmas week, about 1877 (Langdon). Some



Head of White-crowned Sparrow. Natural size.

winters all go farther south toward the Gulf coast, where they abound throughout the colder months, ranging into Mexico and, perhaps, to the Valley of Mexico (Sumichrast *La Naturaleza*, Tomo, V., p. 245).

They are occasionally seen in the southern part of the State in March, possibly only when they remain in the neighborhood over winter. The following indicate the earliest and latest date of first arrival and the earliest and latest date at which last seen in the spring: Brookville, first seen April 13, 1882, May 6, 1897; departed May 3, 1882, May 27, 1892; Bicknell, first, April 14, 1896, April 28, 1895; departed, May 18, 1895; Lafayette, first, April 24, 1897, May 2, 1896; departed, May 13, 1897; Sedan, first, April 30, 1896, May 4, 1894; departed, May 8, 1895, May 10, 1894; Chicago, Ill., first, April 21, 1885, May 9, 1896; departed, May 17, 1897, May 20, 1896; Petersburg, Mich., first, May 5, 1889, May 9, 1888; departed, May 11, 1889, May 20, 1888. In 1896 it remained at North Manchester until June 6 (Bell), and Ulrey and Wallace report it from Wabash County as late as June 10. In the fall they reach the upper part of the State late in September and early in October. Some years they pass through rapidly, others they straggle slowly along, remaining in the vicinity of the Ohio River into November and even all winter. The following dates as to fall migration are given: Sandusky, O., arrived October 11, 1896; departed October 19, 1896; Bicknell, Ind., arrived September 29, 1894, and 1895; departed November 5, 1895; Lafayette, last

seen October 14, 1896; Chicago, Ill., October 3, 1895, October 9, 1896; Brookville, Ind., October 13, 1879, October 16, 1886. In fall they have lost their song and frequent the edges of woods and fields, brier patches, thickets and clumps of weeds. They are then busy eating weed seeds, of which they destroy great quantities. They migrate chiefly through the Mississippi Valley, and thence many turn off northeast to Labrador and Newfoundland where they breed abundantly. Their scarcity and irregularity along the Atlantic Coast has been noted. Its summer range is a little north of that of the next species, consequently they in migrating pass them. It has been found breeding at Rutland, Vt., Potsdam, N. Y., and in Oconto County, Wis. Mr. Nehrling says: "In northern Wisconsin, and especially in northern Michigan—in the Lake Superior region—this Sparrow is a rather common summer bird." Mr. O. B. Warren, however, has never found them breeding at Palmer, Mich. Its food is principally weed seeds and insects, though Audubon adds small mollusks to its bill of fare. I suspect from its habits about our gardens and orchards that it will be found to destroy many injurious insects that frequent such places.

217. (558). *Zonotrichia albicollis* (GMEL.).

White-throated Sparrow.

Adult.—Edge of wing and spot in front of eye (sometimes extending to above eye), yellow; throat, abruptly white; two broad stripes on the crown and a narrow one behind the eye, black; a white stripe in middle of crown, and one over ear-coverts, sometimes extending over eye; ear-coverts and jugulum,, deep ash; back, rusty brown streaked with black. *Immature, First Winter*.—Similar to adult, but head stripes rusty dusky-brown and pale rusty-buff; the yellow in front of eye and white throat-patch, less distinct. *First Plumage*.—Crown, uniform snuff-brown, with a narrow whitish middle stripe; stripe over the eye, dirty-whitish, with no yellow in front of eye; jugulum, streaked with dusky; throat, not abruptly white.

Length, 6.30-7.65; wing, 2.80-3.15; tail, 3.05-3.35.

RANGE.—Eastern North America, west to Montana, north to Labrador and the fur countries. Breeds from Montana, northern Michigan, Ontario and Massachusetts north. Winters from Massachusetts and southern New York south along the Atlantic Coast and in the lower Mississippi Valley, north to Missouri and Illinois. Accidental in Utah, California and Oregon.

Nest, on ground, at base of small bush or clump of weeds; of dry weed stalks, bark, grass, rootlets and hair. *Eggs*, 4 to 5; light blue or bluish-white, dotted more or less with light and dark-brown; .84 by .62. Usually two broods.

The White-throated Sparrow precedes the last mentioned species in both spring and fall migrations. While it remains in the southern part of the State late in the fall, I have no account of its wintering within our limits, though it may do so. Some winters it remains in the vicinity of St. Louis (Cooke), and in Illinois as far north as Wabash, Lawrence and Richland (Ridgway).



Head of White-throated Sparrow. Natural size.

We know it in Indiana as a very abundant migrant, generally in flocks, in March, April and early May, and from September to November. It varies in the date of its arrival in the same locality, both in spring and fall as much as a month. The earliest and latest dates of its first arrival and of its departure in spring at several localities are given: Bicknell, arrived March 11, 1894, March 24, 1895; departed May 1, 1895, May 16, 1897; Brookville, arrived March 13, 1884, April 25, 1881; departed May 1, 1889, May 8, 1886; Lafayette, arrived March 6, 1894, April 13, 1895; Laporte, arrived March 7, 1894, April 12, 1896; departed May 1, 1896; Sedan, arrived April 13, 1894, April 27, 1893; departed May 4, 1889, May 10, 1896; Chicago, Ill., arrived April 12, 1884, April 16, 1896; departed May 6, 1896, May 15, 1886; Petersburg, Mich., arrived April 24, 1889, May 5, 1888; departed May 5, 1889, May 20, 1888. They are to be found among thickets, brier patches and brush piles, either in the open or among the densest woods. From among the thickets and through the long forest aisles their peculiar song comes to one's ear at the time of their vernal visits. In March, when they are present, their songs are seldom heard, but in April, particularly toward the latter part, and in early May, one who visits their haunts is greeted with both solos and choruses as the waves of inspiration come to the inhabitants of the brush-piles with the

intermittent warm southern-breezes. The song is commonly interpreted, *pe-pe-pé-body*, *pe-body*, and from it the singer has been named the "Peabody Bird." Both this species and that last described are scratchers, moving both feet together in turning over the leaves. They are very persistent in this work, and "all is grist that comes to their mill." Be it seeds or insects, they serve as food.

A White-throated Sparrow was taken at Berry Lake, Lake County, Ind., July 23, 1887, by Mr. E. A. Colby (Coale). While they may rarely breed in the northern part of the State, I do not know that they do. In Michigan they breed abundantly northward, and have been found breeding as far south as Grand Rapids (Cook, *Birds of Mich.*, p. 114). They also breed abundantly in northern Wisconsin. They remain with us in spring as late as they can. Often they are seen mating, and some years, when they lingered long, they have been observed carrying sticks, as though they had thought to begin nest-building. Some year, when they remain late, I shall not be surprised to learn that the imperative demands of nature have impelled some of them to make their summer homes with us and build their nests. In fall, some years, they cross the northern line of this State near the middle of September, and linger in their journey southward, feasting upon seeds, wild fruits and insects for a month or more. At that season of the year, the present species and the last are often associated with a number of other birds in a mixed company, frequenting thickets and weed patches. The following gives earliest and latest fall dates of arrival and departure at the places noted: Chicago, Ill., arrived September 16, 1896, September 20, 1894, departed October 24, 1896; Selan, Ind., arrived September 25, 1894, departed October 17, 1889, November 4, 1894; Lafayette, arrived September 26, 1896, October 2, 1894, departed October 17, 1894, October 26, 1895; Greensburg, arrived October 3, 1896, October 19, 1894, departed October 28, 1894, November 17, 1896; Brookville, arrived October 5, 1887, departed October 20, 1883; Bicknell, arrived September 29, 1894, 1895, September 30, 1896, departed, October 17, 1894, November 26, 1896. They winter abundantly in the Gulf States. Mr. H. Nehrling says: "In southern Louisiana a shameless slaughter of our small song birds is going on throughout every winter. In the French Market of New Orleans we notice dead Juncos, Towhees, White-throated and White-crowned Sparrows, Thrashers, Thrushes, Robins, Warblers, etc., by the thousand. We learn from Audubon that even in his time these birds were slaughtered in innumerable numbers in Louisiana. In Texas they are not much molested, except by negroes" (*Birds of N. A.*, Pt. XI., pp. 117,

118). Prof. F. H. King examined 16 White-throated Sparrows, and found they had eaten 4 caterpillars, 4 beetles, 1 grasshopper, and 1 caddis fly; 13 of them had eaten some seeds; 1 had eaten raspberries. Until after July their food is largely insects (Geol. of Wis., I., p. 540).

131. GENUS SPIZELLA BONAPARTE.

a¹. Crown rufous in adults.

b¹. Upper mandible black, lower yellow; dusky spot on breast.

S. monticola (Gmel.). 218

b². Bill wholly black or reddish brown.

c¹. Bill wholly light reddish brown.

S. pusilla (Wils.). 221

c². Bill wholly black in adults; dull reddish brown, lighter below in young.

S. socialis (Wils.). 219

a². Crown grayish brown, streaked with black.

S. pallida (Swains.). 220

218. (559). *Spizella monticola* (Gmel.).

Tree Sparrow.

Adult.—Bill, upper mandible, black, lower, yellow; a black or dusky spot on the middle of the breast; crown, rufous, feathers sometimes bordered with gray; grayish-white stripe over the eye; rufous stripe behind the eye; greater and middle wing coverts edged with rufous and tipped with white, forming two conspicuous bars; secondaries more or less edged with rufous and white; back, brownish, streaked with black and buffy; rump, brownish-ashy; sides of head and neck, ash-gray, lighter on the throat; rest of under parts, whitish, washed with pale brownish. *Immature*.—Similar, but more or less distinctly streaked below.

Length, 6.00-6.50; wing, 2.80-3.10; tail, 2.60-3.90.

RANGE.—North America east of Plains, from South Carolina, Kentucky and Indian Territory, north to Arctic Ocean. Breeds from northern Maine to Labrador and north. Winters from North Dakota, northern Michigan, Ontario and New England, south.

Nest, on ground, or low in trees; of grass, rootlets and hair. *Eggs*, 4-5; pale green, speckled, blotched and scratched with various shades of brown; .74 by .57.

Soon after the Junco, or common Snowbird, appears in the fall, these little winter Sparrows appear. They frequent thickets, weedy places and spots where grasses and sedges have borne seed. There, sometimes alone, sometimes with the Juncos, they may be found, busily engaged seed eating. They generally appear in October in northern Indiana, but sometimes are not noted until November.

That month they spread over the State. From then they are common until they leave in the early spring. In that migration they precede the Juncos, sometimes leaving the southern part of the State early in March, and most always disappearing from our limits before the middle of April. I have known them to arrive at Brookville in the fall as early as October 10, but usually they are much later. The following are earliest and latest dates of first arrival: Chicago, Ill., October 5, 1895, October 20, 1894; Sedan, Ind., October 20 one year, November 4, 1894; Greensburg, November 26, 1896; Bicknell, November 1, 1895, November 8, 1896; Lafayette, November 3, 1894, November 12, 1895. In the extreme northern part of the State, in severe winters, at least, most of them move farther south, but some remain, and it is truly a winter resident throughout the State. They utter a *chip* when they come to us in the fall, and when many are busily feeding together, all chipping at once, the result is a low twittering that plainly tells to the watcher along its border of the lively birds hidden within the weed patch. In winter, when the ground is covered with snow, they often come in companies about barn yards, poultry yards, and even into door yards. Toward the end of their stay, they begin to sing, often ascending a high bush, or even a tree, from which a fine musical selection is rendered. With this period of song, they begin to gather into large flocks, which give forth a full chorus some warm April morning. I have known them to begin singing March 3 (1893), and to be in large flocks in full song March 31 (1896).

Examinations made by the United States Department of Agriculture show that in winter it feeds entirely upon the seeds of weeds, and probably each bird consumes about one-fourth of an ounce a day. Upon this basis, counting ten Tree Sparrows to an acre, it has been estimated they destroy during a season's stay in the State of Iowa alone, 1,750,000 pounds, which equal 875 tons of weed seed (Farmers' Bulletin, No. 54, U. S. Dept. of Agr., p. 28).

The following indicate the earliest and latest dates at which the last birds were noted in spring at the places named: Brookville, March 3, 1893, April 11, 1881; Greensburg, February 22, 1895; Bicknell, March 10, 1895, April 8, 1896; Lafayette, March 8, 1894, March 28, 1896; Sedan, April 4, 1895, April 17, 1893; Chicago, Ill., March 22, 1886.

219. (560). *Spizella socialis* (WILS).*Chipping Sparrow.**

Synonyms, CHIPPY, CHIP BIRD, HAIR BIRD.

Adult.—Bill, black; crown, bright rufous; forehead, black, divided by a short grayish streak; stripe over eye, whitish; streak through and behind eye, black; back, brownish, streaked with black; ear coverts and sides of neck, ash-gray; rump, grayish-blue; wings with two light cross bars. Below, whitish, unspotted, washed with ashy on sides and across breast; wings and tail, edged with lighter, not white. *Immature*.—Bill, dull reddish-brown; crown, colored like the back; breast and sides with dusky streaks; otherwise similar. The grayish-blue rump and more dusky upper mandible serve to distinguish this bird.

Length, 5.00-5.85; wing, 2.55-2.90; tail, 2.20-2.60.

RANGE.—North America, from Mexico north to Newfoundland and Great Slave Lake. Breeds from Gulf States, north. Winters from Indian Territory, south.

Nest, of rootlets and fine grass, lined with horsehair; in bush, vine or tree, generally under ten feet up. *Eggs*, 3-4; pale bluish-green, dotted, speckled or scrawled with dark brown; .69 by .50.

The Chipping Sparrow is familiarly known as the "Chippy," or "Chip Bird." It comes about our doors, upon our porches, and even, at times, into our houses, picking up crumbs that have fallen. Where cats and other enemies do not persecute them, they are very familiar, building their nests in the shrubbery, vines and smaller evergreens. From its habit of using horsehair, preferably black, in its nest, it is sometimes called "Hair Bird." While sometimes they are with us, in southern Indiana, from early March until past the middle of November, rarely into December, I have no knowledge of their remaining over winter. The earliest and latest dates of its spring appearance and fall departure in the localities noted are: Bicknell, March 9, 1897, March 23, 1895, departed October 27, 1895, November 19, 1896; Greensburg, March 1, 1895, April 5, 1894, departed October 17, 1896, December 15, 1894; Brookville, March 10, 1888, April 8, 1881, departed October 24, 1886; Lafayette, March 19, 1894, April 1, 1895, departed November 3, 1894; Sedan, March 30, 1897, April 8, 1895, departed October 31, 1894; Petersburg, Mich., April 3, 1888, April 8, 1897; Chicago, Ill., April 1, 1894, April 14, 1897, departed October 3, 1895.

In the spring the first to arrive are single birds, and these are succeeded in a few days, or, if very early, in a week or two, by flocks of their fellows, which may be seen trooping through the orchards

and fields. Usually the last to arrive are the ones that breed with us. They at once make themselves at home upon our lawns, and announce their arrival by the same old song we heard last year. When the migrants arrive very early in the Whitewater Valley, they do not at once begin singing. They usually begin mating the first ten days of April. The earliest date I have is March 27, 1882. I found them building at Brookville, April 15, 1889. April 29, 1896, Prof. W. P. Shannon noted a nest, with four fresh eggs, at Greensburg. He found a nest, with young recently hatched, May 9, 1896, and I found one with young of the same age, May 9, 1887. Through May and June their nests may be commonly found. Sometimes they rear a second brood. Prof. A. J. Cook notes a nest with eggs taken in Michigan, August 4, 1893 (Birds of Mich., p. 114). Its common note is a sharp *tchip*, and its song a rapid repetition of *tchips*, by which it may readily be distinguished. No other bird that frequents similar situations has a song anything like it. The songs dwindle in July and are seldom heard the latter part of that month, and rarely until near the middle of August. In 1897 I heard one singing, July 24, and after that noted but two more songs, one August 12, and another August 14. Mr. Bicknell (The Auk, Vol. II., April, 1885, p. 145) speaks of a later song period, the latter part of September and early in October. I have never noticed it.

Prof. F. E. L. Beal has shown that about one-third of the food of the Chipping Sparrow, Field Sparrow and Song Sparrow consists of insects, comprising many injurious beetles, such as snout beetles, or weevils, and leaf beetles, many grasshoppers, which form one-eighth of the food of the present species; many wasps and bugs. On the whole, their insect food is mainly injurious species. They are, therefore, beneficial as insect eaters, as well as destroyers of grass and weed seed (Farmers' Bull. No. 54, U. S. Dept. Agr., pp. 26, 27).

In September, they begin to collect in flocks and frequent weedy places, where they are found in company with other birds, principally Field Sparrows.

220. (561). *Spizella pallida* (SWAINSON).

Clay-colored Sparrow.

Synonyms, SHATTUCK, ASHY-NAPE.

Adult.—Bill, reddish, dusky towards tip; crown, grayish-brown, streaked with black, divided by a distinct stripe of pale ashy; stripe over eye, white; ear coverts, light brownish, edged with dusky; nape, ashy; back, brownish, not so rufous as *S. socialis*; striped with black;

rump, grayish-brown. Below, white, the breast and sides tinged with grayish-brown; an indistinct brownish stripe on each side of throat. *Immature*.—More rusty above; streaked with dusky below.

Length, 5.00-5.75; wing, 2.20-2.50; tail, 2.30-2.60.

Remarks.—This Sparrow is smaller than *S. socialis*, and has not the bluish rump.

RANGE.—Interior of North America, north to the Saskatchewan, and from the base of the Rocky Mountains east to Indiana and Michigan. Breeds from northern Nebraska and northern Illinois, north. Winters from central Texas west to Cape St. Lucas and south to Oaxaca.

Nest, of grass, lined with hair; in bush, or on ground. *Eggs*, 3-5; similar to those of *S. socialis*.

Rare migrant; possibly locally rare summer resident. Prof. W. S. Blatchley shot a bird of this species from a flock of Sparrows near Terre Haute, September 27, 1890. This is the only record of its occurrence in this State. Mr. E. W. Nelson notes that specimens have been taken near Chicago, and that it is a rare summer resident about the borders of prairies (Bull. Essex Inst., Vol. VIII., Dec., 1876, p. 108). Prof. A. J. Cook (Birds of Mich., p. 114) notes its occurrence in Michigan, notably in "Covert's Birds of Washtenaw County," and Mr. L. Whitney Watkins took several specimens from about forty seen at Manchester, Mich., September 3, 1894. It has not yet been reported from Ohio. This is one of the birds of the interior plains of America, extending eastward to the old prairie limits. Mr. E. E. Thompson says it has a singular lisping song, which he describes as follows: "The bird mounts some perch, and, with head thrown back and with gaping beak, utters a sound like a fly in a newspaper—'scree-scree-scree'—sometimes giving but one note, and at other times, in the height of the season especially, repeating the dulcet note five or six times" (Proc. U. S. Nat. Mus., Vol. XIII., pp. 601, 602).

"This species is readily distinguishable from the other American *Spizellas*, except *S. breweri*, in the dark streaks and medium ashy stripe on the crown, the paler tints, the dark line on the side of the chin, etc." (B. B. and R., History N. A. Birds).

Prof. F. H. King examined the stomachs of 13 and found they contained 6 beetles, 12 hemiptera, principally plant lice: 1 grasshopper, 1 larva, and other insects; 7 had eaten small seeds (Geol. of Wis., I., p. 540).

221. (463). *Spizella pusilla* (WILS.).*Field Sparrow.**

Adult.—Bill, light reddish-brown; crown, rufous, faintly marked with grayish; line over the eye, nape and sides of head, grayish, the latter tinged with ashy; faint rufous streak behind the eye; back, rufous, feathers with black centers and ashy edgings; wings crossed by two whitish bars; rump, brownish-ashy. Below, white, unmarked, but washed with pale brown on breast and sides. *Young*.—First plumage streaked below.

Length, 5.10-6.00; wing, 2.45-2.70; tail, 2.50-2.80.

RANGE.—Eastern North America, from Gulf States and Texas, north to Manitoba and Quebec. Breeds from South Carolina and Kentucky, north. Winters from southern Illinois, southern Indiana and Virginia, southward.

Nest, on ground or in low bush; of rootlets and grass, and lined with hair or fine grass. *Eggs*, 3-5; greenish-white, variously marked with rufous; .68 by .51.

The Field Sparrow is much more numerous than the Chipping Sparrow, but is not such a social bird. It is not found about our homes as closely as the "Chippy," but keeps a little farther away. In the back orchard, in old fields and pastures, especially if more or less overgrown by bushes, it makes its home.

Occasionally, at least, it winters in the Wabash Valley, from Knox County, southward. Prof. J. A. Balmer reported it wintering at Vincennes the winter of 1887-8. Elsewhere it is a common summer resident, arriving, some years, very early and remaining quite late. The earliest and latest date at which it has been first seen at the following places is given: Brookville, February 25, 1892, April 12, 1894; Spearsville, March 9, 1897; Lafayette, March 28, 1897, April 10, 1895; Sedan, March 30, 1897, April 6, 1894; Laporte, April 12, 1896, April 13, 1894; Chicago, Ill., April 3, 1886, April 17, 1897; Petersburg, Mich., April 5, 1893, April 26, 1897.

Late in March it adds to soft pastures and greening grass the charm of a delightful song. Its voice is clear and its song distinct and far reaching, as well as sweet and plaintive. There is no bird in the old pastures that can equal it, as from fence or bush or old weed stalk it carols to the wind—a song that is borne to a surprisingly long distance. I have been upon a hill over a hundred feet above a Field Sparrow that was singing five hundred feet away, and the wind, coming my way, brought to me distinctly, but faintly, its April

song. Its song comes with the blooming of the violet, innocence and the Virginia cowslip. John Burroughs says: "Its song is like the words, *fe-o, fe-o, fe-o, few, few, few, fee, fee, fee*, uttered at first high and leisurely, but running very rapidly toward the close, which is low and soft." The song continues practically through the summer. Some singers drop out, but many are still singing the first of August, and not a few a week or two later. August 10, 1897, I



Field Sparrow.

(Beal.—Farmers' Bulletin, 54. United States Department of Agriculture, p. 27.)

heard several singing as well as they did in April. September 14, I found one trying his best to sound the notes, but his effort was very imperfect.

I have observed them mating as early as March 20 (1897). They are usually found nesting in May, June and sometimes July. Earliest nests noted at Brookville, May 7, 1883, May 11, 1881. Two or three broods are reared. August 28, 1896, I found a nest and eggs near Brookville. I have referred to their food habits under the last species. Prof. F. H. King, in addition, notes that 7 he examined ate a caterpillar, 2 grasshoppers, a heteropterous insect, a harvestman, a spider; 4 had eaten small weed seeds (Geol. of Wis., I., p. 539).

In September they begin to collect into flocks, and are found in great numbers among the weeds and brier patches. The latter part of that month they mostly leave northern Indiana, and through October all disappear from our northern counties, and most of those from farther south. There, however, some remain well into November, even when they do not winter. The latest fall records I have are Chicago, Ill., September 30, 1895; Lafayette, Ind., October 13, 1896; Brookville, November 11, 1886.

132. GENUS JUNCO WAGLER.

α^1 . Sides grayish.
 α^2 . Sides brownish.

J. hyemalis (Linn.). 222
J. hyemalis shufeldti Coale. 223

222. (567). *Junco hyemalis* (LINN.).

Slate-colored Junco.

Adult Male.—Upper parts, throat and breast, blackish or slate-gray; in winter washed with brownish above; belly, abruptly white; two outer tail feathers and part of third, on each side, white; bill, flesh color. *Adult Female*.—Similar, but upper parts browner and throat and breast paler. *Young*.—First plumage, streaked above and below with black.

Length, 6.00-7.00; wing, 3.15-3.65; tail, 3.00-3.29.

RANGE.—North America, mostly east of the Rocky Mountains, breeding on the higher Alleghany Mountains from Virginia, from the mountains of southern New England and northern Minnesota to Alaska. In winter, south over the eastern United States to Gulf States. Straggling westward to Arizona and California.

Nest, on or near the ground; of grass, moss and rootlets, lined with finer material. *Eggs*, 3-5; whitish, speckled with reddish-brown; .76 by .58.

The Slate-colored Junco over most of Indiana is known as the Snowbird. In some localities, to distinguish it from the Snowflake, or Snow Bunting, which is termed "White Snowbird," it is called Black Snowbird.

From the middle to the last of September they begin to appear in northern Indiana, arriving first about the lower end of Lake Michigan. In the southern portion of the State, a few are seen from the 1st to the 20th of October. Their presence is usually announced by a sharp *tchip*, followed by a rapid chipping as it flies. Then the dark, slate colored body and the conspicuous white feathers on

either side of the tail render identification easy. From the extreme northwestern part of the State the greater part of the Juncos disappear with the coming of severe weather, and return from the south in February or March. They frequent all kinds of places. When they first come, thickets and fence rows are preferred. But while they are with us they frequent stubble and brier-patch, upland and riverside, heavy wood and swampy thicket, and, when the weather is severe and snow covers the ground, the barn yard and door yard. Often they are associated in flocks with the Tree Sparrows. The earliest and latest dates of first arrival and of latest departure from the localities named are given: Chicago, Ill., arrived September 16, 1896, departed in spring April 30, 1895; Sedan, Ind., arrived September 30, 1894, departed April 15, 1896; Lafayette, arrived September 22, 1894, October 12, 1895, departed April 18, 1895, May 2, 1893; Bicknell, arrived October 2, 1895, October 1, 1896, departed April 16, 1896, April 22, 1895; Brookville, October 6, 1887, October 19, 1895, departed April 11, 1883, April 26, 1892 and 1897; Trafalgar, September 25, 1897. Some years individuals remain in this latitude quite late. Prof. S. A. Forbes notes taking one June 9, one mile from the Ohio River, near Elizabethtown, Hardin County, Ill. (Bull. N. O. Club, July, 1881, p. 180). Dr. J. M. Wheaton notes that he has seen it in July, in Portage County, O., and says it is "resident throughout the year in northeastern Ohio" (Birds of O., p. 332). It is a common summer resident in Michigan, north of Traverse City. It has been noted at Locke, July 8, 1879; Grand Rapids, July 13, 1878 (Cook, Birds of Mich., p. 115). From Indiana, however, I have no records after early May. They begin to think of mating before they leave us. Sometimes, during a spell of warm weather, near the middle of March, we begin to hear their love songs. The first heard at Brookville in 1896 was April 11, but this year (1897) I heard the first song March 18. It came from a Junco in an apple tree in my yard. When singing, the bird gets among the thickest of the branches of an apple, cedar or other tree. It is very difficult to see there. When singing, it makes little or no movement, remaining for quite a while in the same place, and when its head is turned away from the observer the ventriloquial effect is such that the singer is hard to locate. The Junco utters a pleasant, little vibratory song, usually consisting of four notes, all in the same key. Often there are but three notes, and occasionally it utters five or six. The song is repeated every three to five seconds for as much as a quarter of an hour at a time. It resembles *tee-ti-ti-tee*, and suggests to me the rattling of a note over a cog wheel, going at an unvarying rate of

speed. The food of the Junco is substantially the same as that of the Tree Sparrow. Both are valuable as destroyers of the seeds of noxious plants.

223. (567b). *Junco hyemalis shufeldti* COALE*

Shufeldt's Junco.

Similar to *J. hyemalis*, but with the head dull black, the back browner, and the sides brownish-vinaceous.

Wing, 3.05-3.14; tail, 2.75-2.89; tarsus, .72-.74; bill, .40-.43.

RANGE.—Rocky Mountain region, west to California, south to Arizona, Texas and northern Mexico. Accidental in Illinois, Indiana, Michigan, Massachusetts, Maryland, etc.

Accidental winter visitor. There is only one record known of the occurrence of this western form in Indiana. A specimen was killed by Mr. Ralph S. Wickersham in the yard of Mr. Thomas Cory, in West Lafayette, January 20, 1891. It was shot for food for a captive Barn Owl, *Strix pratincola*, but observing it differed from the ordinary Junco, it was forwarded to the Smithsonian Institution, at Washington, where it was identified as this form. For the information, and, finally, for the specimen, I am indebted to Dr. Erastus Test, and to Messrs. L. A. and C. D. Test. Mr. H. K. Coale had a specimen in his collection, taken at Waukegan, Ill. (The Auk, Oct., 1887, p. 331).

133. GENUS *PEUCÆA* AUDUBON.

***224. (575a). *Peucæa aestivalis bachmanii* (AUD.).**

Bachman's Sparrow.

Adult.—Above, rufous, streaked with gray, and sometimes spotted on the back with black; buff stripe over eye; dusky stripe on each side of chin; below, grayish-buff, whitening on the belly; edge of wing, yellow.

Length, 5.30-6.25; wing, 2.25-2.60; tail, 2.38-2.95.

RANGE.—Mississippi Valley, north to southern Illinois and central Indiana (Warren County), west to north Texas, east to east Tennessee, Georgia and North Carolina. Breeds throughout its range.

Nest, on ground; of grass, usually domed and cylindrical. *Eggs*, 3-4; white; .74 by .60.

Summer resident in the southwestern quarter of the State, usually not common.

Bachman's Sparrow was first reported from the lower Wabash Valley by Mr. Robert Ridgway, who noted it early in June, 1871, about half way between Mt. Carmel and Olney, Ill. August 11, 1871, he found it rather rare at Mt. Carmel. In July and August, 1875, Messrs. E. W. Nelson and F. T. Jencks took several specimens in the vicinity of Mt. Carmel and on Fox Prairie, in Richland County, about thirty-five miles to the northward of Mt. Carmel (Ridgway, *Birds of Ill.*, I., pp. 281, 282). April 26, 1881, Mr. Ridgway found it near Wheatland, Knox County, Ind., and nearly ten years later informed me it was not uncommon in all parts of Knox County that he had visited. April 24, 1884, Prof. W. S. Blatchl y took two Bachman's Sparrows from a brush pile in Monroe County. That was its first record there. It appeared regularly thereafter between April 6 (1885) and April 29 (1886). In 1886 two sets of eggs were found and, perhaps, a half dozen birds taken (Evermann). It was first noted in Putnam County by Mr. Alexander Black, April 18, 1891, and has appeared regularly there since, between April 7 and 18. It is tolerably common there now (1897). May 15, 1893, Mr. Jesse Earlle took a nest and four eggs, but slightly incubated, near Greencastle. He flushed the parent from the nest and shot her. The nest was placed on the ground, at the edge of a little patch of woods, in a blue grass pasture. It was composed of grass, and reminded him of the nest of a Meadow Lark. It was not arched over. The eggs were pure white. Mr. V. H. Barnett first observed it in Brown County, in 1894. He took its nest and four eggs near Spearsville, in the southern part of that county, May 22, 1894. He observed it April 1, 1895, and April 7, 1897. He found it July 30, 1897, in Parke County, and last saw it September 10, 1897, in Vermillion County. He writes he did not see it north of southern Warren County. In Kentucky, the late Mr. C. W. Beckham found it in Nelson County, April 28, 1877 (*Ky. Geol. Surv., Birds of Nelson Co.*, p. 28). Mr. Ridgway says it frequents weedy fields, in which scattered dead trees are standing. Mr. Nelson (*Bull. Essex Inst.*, Vol. IX., p. 38) says it was "found about the fences or brush piles in half cleared fields. They were shy, and quite difficult to secure, from their habit of diving into the nearest shelter when alarmed, or skulking, Wren-like, along the fences, dodging from rail to rail."

Their song has been said by more than one to recall the effort of the Field Sparrow. Mr. Ridgway says it resembles the syllables *the-e-e-e-e-e-thut, lut, lut, lut*, the first being a rich, silvery trill, pitched in a high musical key, the other syllables also metallic, but abrupt, and lower in tone. They sing throughout the day, and even

when the day is gone and darkness reigns, they sing on. Mr. Beckham mentions the ventriloquial effect of their voices. When surprised, the birds, instead of flying, run or glide through the grass, like a mouse or snake, and utter a sound more like the hissing of a snake than the scolding of a bird. It is said not to be difficult to mistake the escaping bird for a gliding snake. The theory has been advanced that Bachman's Sparrow imitates, as far as possible, the movements and hiss of a snake, as a means of protecting its nest (Nehrling, N. A. Birds, XII., pp. 149-151).

134. GENUS MELOSPIZA BAIRD.

¹. Breast and sides distinctly streaked at all ages.

*b*¹. Maxillary stripe and breast white, the latter heavily streaked.

M. fasciata (Gmel.). 225

*b*². Maxillary stripe and breast buff, the latter lightly streaked.

M. lincolni (Aud.). 226

*a*². Breast and sides unstreaked, except in young (first plumage).

M. georgiana (Lath.). 227

***225. (581). *Melospiza fasciata* (Gmel.).**

Song Sparrow.

Maxillary stripe, throat and other lower parts, white; sides and crissum, washed with brownish; they and sides of throat streaked with dark brown and black; breast with broad wedge-shaped streaks of black and brown, which often unite to form a large spot in the center; crown, rufous, divided in the middle by dark gray streak; each feather streaked with black; line over eye, light gray; stripe back of eye, and one on each side of maxillary stripe, rufous brown; other upper parts, rusty-grayish, streaked with brown and black; tail feathers, rufous brown above, the middle feathers blackish along their shafts, and often with obsolete wave markings.

Length, 6.00-6.75; wing, 2.45-2.80; tail, 2.58-3.02.

RANGE.—Eastern North America, west to base of Rocky Mountains; north to Manitoba and Nova Scotia. Breeds from Virginia, northern Kentucky, southeastern Indiana and northern Illinois, northward. Winters from Indiana and Massachusetts, southward.

Nest, on ground or in bush; of grass, leaves and bark strips, lined with grass and hairs. *Eggs*, 4-5; light greenish or bluish-white, marked with brown; .79 by .59.

The Song Sparrow is a resident throughout the State. In the northern portion, most of them leave during the severest part of the winter. This is more noticeable late years, since so many of the

thickets have been cut away. In the extreme southwestern part of the State, they are rare in summer, as they are in Nelson County, Ky. (Beckham), and in southern Illinois (Ridgway). The last named gentleman says: "While the Song Sparrow breeds in the extreme northern part of Illinois, it is known in the southern portions only as a winter resident, * * * abundant, but very retiring, inhabiting almost solely the bushy swamps in the bottom lands, *and unknown as a song bird.*" He also notes that it breeds at Paris, Edgar County, Ill. (Birds of Ill., I., pp. 283, 284). In Indiana it breeds, and its songs are heard through summer, at least, as far south as Jefferson and Knox counties. It has been reported as breeding in Dearborn, Brown, Monroe, Putnam, Vigo, Sullivan and Knox counties. In Franklin County, I have found it begins singing early, sometimes by February and keeps at it all through spring, summer and fall. I sometimes wonder if its song is not sung on bright days every month in the year.

I heard one singing October 5, 1897. The migrants return to northern Indiana in February and March. The following are early and late dates on which the first returned: Sedan, February 9, 1894, March 8, 1897; Laporte, March 1, 1894; Petersburg, Mich., March 4, 1889, March 10, 1897; Chicago, Ill., March 10, 1894, March 23, 1896. Everywhere they are most numerous during the migrations.

I have found them mating at Brookville as early as February 27 (1886), and have found nest and eggs April 28, 1883. Mr. J. O. Snyder reports nest and eggs at Waterloo, April 28, 1885. Two broods are reared in a year. Nests have been found as late as July 23, 1893, and August (Cook, Birds of Mich., p. 115). The Song Sparrow frequents thickets along streams and in low ground generally, also gardens, small fruit farms, and bushes and hedges along highways. It is a well-known bird, and its song, although not so attractive as that of the Field Sparrow, or so pleasing as that of the Vesper Sparrow, exceeds that of most of our common birds. It is the best singer about our gardens. Dr. T. M. Brewer said it sounded to him like *sh'nide-sh'nide-sh'nide-sh'nide-ze ze ze ze ze ze*, the first four syllables slow, the rest in quicker time. As has been noted under the Chipping Sparrow, its food has been found to be about one-third insects and the great bulk of the remainder is grass and weed seeds. Prof. F. H. King examined 52 specimens, of which 29 ate more or less seeds; 1 ate 2 kernels of wheat. The total insect food was 11 lepidoptera, 25 beetles, 5 grasshoppers, 4 grasshoppers' eggs, 2 dragonflies, 1 cricket, 1 spider, 1 millipede, 4 dipterous insects, 1 heteropterous insect (Geol. of Wis., I., p. 538). Brewer says they eat caterpillars and other larvæ. The canker worm is a favorite article of food.

226. (583). *Melospiza lincolnii* (AUD.).**Lincoln's Sparrow.**

Synonym, LINCOLN'S FINCH.

Maxillary stripe, breast, sides and crissum, buff; other lower parts, whitish; breast and sides, with narrow black streaks; black stripe on each side of throat and one above maxillary stripe. Crown, chestnut, each feather with a black streak, divided by middle stripe of ashy; stripe over eye, ashy; rest of upper parts, brownish-gray, streaked with black and grayish; tail, grayish-brown, feathers darker along the shafts; wings edged with light rufous and whitish.

Length, 5.25-6.00; wing, 2.30-2.50; tail, 2.40-2.70.

Remark.—The buff breast easily determines this Sparrow.

RANGE.—North America, from Guatemala to Labrador and Alaska. Rare east of the Alleghanies. Breeds from northern Illinois and northern New York north; also south, along the higher Rocky Mountains almost to Mexico. Winters from southern Illinois south.

Nest, of grass; on or near ground. *Eggs*, 3 to 5; pale greenish, spotted and blotched with several shades of reddish-brown, more prominent at the larger end; .78 by .58.

In Indiana this Sparrow is a regular but rare migrant over most of the State. It is generally found in May and October, and passes farther north to breed. In the lower Wabash Valley it is more numerous. The spring of 1881 Mr. Robert Ridgway found them very abundant in Knox County. In 1888 they arrived at Terre Haute, April 17, and departed May 5. At Brookville, in 1886, it was first noted April 24; in 1880, May 11; in Starke County, May 11, 1884, May 11, 1890; Lake County, May 16, 1880. It has also been taken in Carroll and Monroe counties. Mr. E. W. Nelson says they occur in Cook County, Ill., and vicinity between May 8 and 20 and September 20 and October 5. Dr. Gibbs reports it from Michigan (Kalamazoo?) October 9, 1879 (Cook, Birds of Mich., p. 116). It was taken at Brookville, Ind., October 2, 1879. When found in May, often two or three are together. Possibly they are then paired. Mr. J. G. Parker, Jr., collected a young male of this species on the east shore of Calumet Lake, Cook County, Ill., July 16, 1896. It has been found nesting in Hamilton County, N. Y., and at Racine, Wis., and may do so about the lower end of Lake Michigan.

In many respects its habits resemble those of the Swamp Sparrow. Generally it is found throughout the migrations in similar places; among bushes, drift and reeds about watercourses and bodies of water.

It also is found along bushy ravines, in woods, among bushes and about brush piles in swampy ground. One specimen was taken in a cloverfield near Brookville by Mr. E. R. Quick. It is an inconspicuous species and doubtless is generally overlooked. It is shy and retiring, preferring at all times to move under cover and to fly when hidden from view by an intervening object. The first specimens reported from Franklin County were two taken near Brookville by Dr. F. W. Langdon and Mr. J. W. Shorten, May 10, 1879. Dr. Langdon says of them: "The birds were found in a damp, wooded ravine traversed by a small stream, one of them hopping about on a mass of drift in search of small aquatic insects and larvæ, with which its stomach was found to be filled" (Journ. Cin. Soc. Nat. Hist., July, 1880, p. 124). Its food is insects, fruit and seeds.

***227. (584). *Melospiza georgiana* (LATH.).**

Swamp Sparrow.

Adult in Summer.—Breast, sides of head, nape and stripe over eye, gray; sides, pale grayish-brown, indistinctly streaked; belly, white; crown, light chestnut; forehead, black, ashy stripe dividing both in the middle; black stripe behind the eye; back, brownish-gray; upper parts, striped with black, and on the back also with brown, ashy and whitish; wings and tail feathers, edged with rufous, the latter dark along the shafts; tertials and larger wing-coverts, black-tipped, more or less edged with whitish. *Adult in Winter and Immature.*—Crown and upper parts, more blackish; more or less streaked on breast.

Length, 5.25-6.00; wing, 2.30-2.50; tail, 2.40-2.70.

RANGE.—Eastern North America. Breeds from northern Indiana north to Labrador and Manitoba. Winters from southern Illinois south to Gulf of Mexico.

Nest, in wet meadow or swampy thicket; on ground or in tussock of grass; composed of plant stems, lined with fine grass. *Eggs*, 4 to 5; greenish-white to light green, clouded and spotted with various shades of brown; .78 by .56.

Regular migrant over most of the State; in the extreme northern part it is, in some localities, an abundant summer resident, breeding in great numbers, even outnumbering the Song Sparrows. In the lower Wabash Valley some may remain through the winter. It is reported as wintering in southern Illinois. There, Mr. Ridgway says, it congregates in immense numbers—perhaps exceeding those of any other species in the sheltered swamps of the bottom lands. By reason

of its frequenting the thickets of low lands and swampy places generally—localities usually but little visited by most persons—it is not often observed. It was noted at Bloomington, March 5, 1895, where it remained until April 19. The following dates give extremes of first appearance in spring: Brookville, April 11, 1884, April 25, 1885; Lafayette, March 6, 1894, April 27, 1897; Laporte, April 2, 1894; Terre Haute, March 28, 1888; Richmond, April 16, 1897; Waterloo, March 17, 1894, April 11, 1896; Chicago, Ill., March 28, 1895, April 1, 1897. They usually have all passed by the latter part of April, but were reported from Terre Haute May 1, 1890; Richmond, May 10, 1897; and several were seen at English Lake, May 10, 1891.

In the fall they are observed leaving their summer homes early in October, and at that time begin to appear in the southern part of the State. They were reported from Cook County, Ill., October 6, 1893, and October 12, 1895, and were noted at Brookville, Ind., October 5, 1897. They have not been reported as breeding south of the northern tier of counties. They are known to breed commonly in Cook County, Ill., and in Lake County, Ind., and tolerably commonly in Dekalb County. There it sings its song, but during the migrations it is songless. Beginning in May, it continues singing, with a slight interruption in August or September, until October. Its fall song is pronounced its best. Mr. Nehrling says its song resembles the syllables, *chee-chee-chee-chee-ze-ze-ze-ze-ze*, and declares that while it resembles somewhat the melody of the Field Sparrow, it is louder and more varied. He says: "Its food consists of small caterpillars, beetles, worms and such insects as are usually found near water. During fall and winter they eat largely of the seeds of weeds and grasses" (N. A. Birds, Pt. XII., pp. 161, 162). Prof. King examined 25 specimens: 13 ate seeds of grasses, sedges, etc.; 1, an ichneumon fly; 1, a chalcidian (?); 1, a moth; 6, 13 beetles; 2, 2 hemiptera; 2, 2 grasshoppers; 1, 6 snails, and 5, 13 larvæ (Geol. of Wis., I., p. 537).

135. GENUS *PASSERELLA* SWAINSON.

228. (585). *Passerella iliaca* (MERR.).

FOX SPARROW.

Synonym, FOX-COLORED SPARROW.

Above, bluish-ashy, more or less marked with rufous and rufous-brown; bright rufous on upper tail-coverts and tail; wings, edged with rufous, with two narrow white cross bars. Below, white; sides heavily streaked with brown; breast and other forward parts, marked with triangular spots and pointed streaks of black and rufous; bill, yellow below; darker above.

Length, 6.20-7.50; wing, 3.30-3.70; tail, 2.80-3.15.

RANGE.—Eastern North America, from the Gulf States to Alaska and the Arctic Coast. Breeds from the mouth of the St. Lawrence River and Manitoba north. Winters from southern Indiana and Virginia south.

Nest, on ground or in bush, or low tree; of grass, rootlets and moss, lined with hair and feathers. *Eggs*, 4 to 5; pale bluish, evenly speckled or heavily blotched with umber or vinaceous-brown; .80 by .63.



Bill of Fox Sparrow.

This large, trim, fox-colored Sparrow appears to be an aristocrat among his fellows. They are common migrants during March and April, and October and November. Mild winters some are winter residents in the extreme southern part of the State, and others remain all but a few weeks in the lower Whitewater Valley and, perhaps, farther north. The winter of 1888-9 they remained all winter at Vincennes (Balmer). Mild winters they remain most of the winter in Putnam County (Clearwaters). The extreme records of first arrival are: Brookville, February 16, 1881, April 1, 1885; Spearsville, March 6, 1894, and 1897, March 13, 1895; Bicknell, March 7, 1897, April 5, 1896; Lafayette, March 6, 1894, March 28, 1896; Wabash, March 11, 1894; Sedan, March 30, 1897, April 18, 1896; Chicago, Ill., March 18, 1893, April 1, 1897. Most have passed north before the last of April and are rarely found in early May. Bloomington, April 20, 1895; Spearsville, April 19, 1895; Laporte, May 1, 1896; Richmond, May 4, 1897, are extremely late dates. They are retiring birds, frequenting thickets, brier patches and brush piles, where they are associated with Towhees and Cardinals. Like the former, they spend much time upon the ground scratching among the leaves. They are on good terms with the Juncos, and when they visit their homes associate with them. They pass northward ahead of the Juncos and go farther north to breed. With us the Fox Sparrow utters a sharp *tchep*. It is said to have a clear, loud, melodious voice, and to sing a sweet song, which I have never heard, but hope to some spring, as they should occasionally give us a foretaste of the musical treat that

is wasted—humanly speaking—on the uninhabited Hudson Bay region. In autumn they begin to reach northern Indiana late in September. Five were reported from Lebanon, September 28, 1894. They were noted at Chicago, Ill., September 30, 1896, October 27, 1883; Lafayette, Ind., October 17, 1895, November 3, 1894; Bicknell, November 20, 1896; Greensburg, November 30, 1894. Prof. F. H. King examined three specimens, one of which had eaten 50 chinch bugs; the other two, small seeds.

136. GENUS *PIPILO* VIEILLLOT.***229. (587). *Pipilo erythrophthalmus* (LINN.).****Towhee.**

SYNONYMS, CHEWINK, TOWHEE BUNTING, JEWEE, JOREE, MARSH ROBIN, GROUND ROBIN.

Adult Male.—Black; belly, white; sides, chestnut; crissum, fulvous-brown; primaries and inner secondaries, with white touches on the outer webs; outer tail feathers, with the outer web and nearly the terminal half of the inner web, white; the next two or three, with white spots, decreasing in size; bill, blackish; feet, pale brown; iris, red in the adult, white or creamy in the *young* and generally in winter specimens. *Female*.—Rich, warm brown, where the male is black; otherwise similar. *Young*.—Streaked brown and dusky above; below, whitish, tinged with brown and streaked with dusky.

Length, 7.50-8.75; wing, 3.30-3.75; tail, 3.55-4.10.

RANGE.—Eastern North America, east of Texas and Dakota; north to Manitoba and Labrador. Breeds from Georgia and lower Mississippi Valley north. Winters from Indiana and Pennsylvania south.

Nest, on ground, or near it; of leaves and shreds of bark, lined with grass and leaves. *Eggs*, 3-5; white, uniformly and thickly speckled with different shades of rufous; .95 by .70.

The Towhee is a common resident in southern Indiana north at least to the latitude of Vincennes and Brookville, and some winters over the greater part of the south half of the State. Occasionally, in mild winters, a few winter throughout the State, and even in Michigan. Over the greater part of our territory, however, the bird is best known as a common summer resident. It is distributed everywhere among bushes and thickets. At some seasons it frequents the densest woods; at others, it enters the larger towns. Its well-known call, uttered by both sexes, and variously interpreted, has given it a name everywhere. The female does not sound the final *k* in *chewink*, which is distinctly

given by the male. The other names refer to its being, in some places, a frequenter of marshy thickets and of spending much of its time upon the ground. There it enjoys turning over the old stems and fallen leaves. It is pre-eminently the scratching sparrow. In October, in a river valley, among some thicket of willows, cottonwoods, and young sycamores, where wild sunflowers, horse-weeds and poke grow rampant, the whole woven together by the interlacing of wild cucumber vines, the number, and the varied, miscellaneous company of birds found there is a revelation to the one who visits it for the first time. Among the babel of voices and the flitting forms may be observed Blue Jays, White-throated and White-crowned Sparrows, Fox Sparrows, Swamp Sparrows, Song Sparrows, Field Sparrows, Indigo Buntings, Juncos, Cardinals, Hermit Thrushes, Chats, Long-billed Marsh Wrens, House Wrens, Carolina Wrens, Winter Wrens, Tufted Titmice and Downy Woodpeckers. In winter, when many of these are gone, whether we go to the woods or follow the fringing bushes of some little run, the Towhee will be found, and not alone, for the Cardinals, Juncos and Tree Sparrows, at least, will be found occupying the same haunts. In spring, when the vegetation has fallen, been broken down or burned away, the old companions return and are more readily seen. The variations in the time of its occurrence may be illustrated by the following dates: At Greencastle they remained all the winter of 1894-5, but in 1896 were not noted until April 4. They were first seen in Lafayette, March 6, 1894, March 28, 1896; at Sedan, March 1, 1894, March 30, 1896; Laporte, March 4, 1894, March 28, 1896; Petersburg, Mich., March 17, 1889, March 25, 1893; Chicago, Ill., March 20, 1884, April 17, 1886. They are rarely common in the north part of the State before April 1, and about Chicago, Ill., sometimes are not common until April 15 to 25. Most of them disappear from our northern counties through September and October. The latest records I have are: Chicago, October 12, 1895; Sedan, October 22, 1889; Lafayette, October 12, 1894, 1895.

In the lower Whitewater Valley I have found them mating March 21, 1883; paired, March 31, 1885, and building, April 5, 1884. They occasionally nest quite early and raise two, perhaps three, broods. Nests have been noted at Sedan with the birds sitting at the extreme dates March 15 and August 17 (Mrs. Hine). In Lake County a nest and three fresh eggs were taken in July, 1882 (Meyer). Eggs were found at Waterloo, June 24, 1885 (Snyder). Mr. V. H. Barnett found young in southern Vermillion County, August 4, 1897.

The nuptial song is beautiful and striking. The male, from the top or some high bush or high upon the principal limb of an isolated tree,

again and again repeats its score. Finally it flirts its tail and flies down to some brush pile, within which it disappears, and the call, *chewink*, comes from the hidden depths of the heap. Its song sounds something like, "*look-out, ter-r-r.*" The first syllable has a rising inflection; the second is slurred. Mr. E. E. Thompson interprets it as, *chuck-burr, pill-a-will-a-will-a.* They begin singing some springs by the middle of March, and while most cease in June, they may occasionally be heard well into July. "Of seventeen specimens examined, five had eaten small seeds; one raspberries; one, seven moths; three, nine beetles; one, wheat; one, oats; one, a wasp; one, an ichneumon; two, three grasshoppers; two, two cockroaches; one, a walkingstick (*Spectrum femoratum*), and four of its eggs; and one, a larva" (King, Geol. of Wis., I., p. 543). Other authorities agree that this species is decidedly insectivorous and beneficial.

137. GENUS CARDINALIS BONAPARTE.

*230. (593). **Cardinalis cardinalis** (LINN.).**Cardinal.**

Synonyms, CARDINAL GROSBEEK, REDBIRD, VIRGINIA CARDINAL.

Adult Male.—With a conspicuous crest; plumage, rich vermillion or rosy-red, obscured with ashy on the back; throat and face, black; bill, reddish; feet, brown. *Adult Female*.—Ashy-brown; paler below, with evident traces of red on the crest, wings, tail and under parts.

Length, 7.50-9.25; wing, 3.55-4.00; tail, 3.90-4.60.

RANGE.—Eastern United States west to Texas and Kansas; north to Iowa, Indiana and southern New York. Casually or rarely to Maine, Ontario, southern Michigan and Minnesota.

Nest, in bushes or vines, three to ten feet up; of twigs, bark, grass and leaves, lined with grass. *Eggs*, 3-4; white, bluish or greenish-white, spotted with rufous-brown, lavender and gray; .99 by .73.

The Cardinal is the most noticeable feature of our avian fauna. Whether we consider its beautiful dress, its cheery song, its good habits or its beneficent deeds, there is nothing that cannot be admired. It is resident throughout the State, being very common in the southern part, north at least to Vermillion and Warren counties, Greencastle, Indianapolis, Connersville and Brookville. Throughout the northern half of the State in some localities they are quite rare. There some winters they disappear, others they remain. They are often more numerous in spring and fall than at other seasons. They are very rare and of irregular occurrence in the northwest portion of the

State beyond the Wabash Valley. It has not been reported from Lake County; is rare in Cook County, Ill.; Porter County, scarce (Trouslet); rare winter resident at Kouts (Parker); Laporte County, Michigan City, one record (Byrkit). In the northeastern part of the State it is more numerous and seems to be increasing in numbers and extending its range into Michigan. I have winter records from the following counties: Steuben, Angola, several the winter of 1896-7 (Mrs. Sniff); Dekalb, the following winters: 1888-9 (Snyder); 1889-90, 1890-91, 1892-3, 1894-5 (Mrs. Hine); Allen (Stockbridge); Elkhart and Kosciusko (Juday); Fulton (Gould). In Michigan it has been taken in Hillsdale, Lenawee, Monroe and Kent counties, and at Detroit (Cook, *Birds of Mich.*, p. 117).

By the first of March the Cardinal begins its songs. Both sexes have the gift, but the male is the superior singer. Mating follows soon after the opening of the season of song. I observed the beginning of their courtship, March 7, 1887. Mr. Robert Ridgway says one that he studied had six very distinct songs. He adds: "The difficulty of expressing a bird's notes by words is well known, but the following attempt may give some idea of the different songs of my Cardinal:

- I. Hoit—whoit, whoit, whoit (eleven times); hoit—whoit, whoit, whoit (eleven times).
- II. Wheú, wheú, wheú, wheú, wheú.
- III. Tchew, tchew, tchew, tchew, tchew.
- IV. Bird'ie, bird'ie, bird'ie — tchew, tchew, tchew, tchew.
- V. Bird'ie, bird'ie, bird'ie, bird'ie, bird'ie, bird'ie.
- VI. Whoy'it—whoy'it, whoy'et, whoy'et, chi-chi-chi-chi-chi-chi (a jingling trill so long continued that it apparently ended only when the singer became out of breath).

"The notes of many Cardinal Grosbeaks are clear and tender—far sweeter than the mellowest notes of fife or flageolet."

The above songs are readily recognized as good interpretations in our language of the efforts of many individuals we have heard. In some of its notes there is some resemblance to those of the Carolina Wren. Mr. Nehrling interprets its ordinary song as: "Jehu-jehu-jehu-jehu-teú, teú, teú, teú, trrrrrrrr." Such is the translation. To know the song one must hear it and feel it. No keener interpreter of Nature has caught its spirit than Hon. B. S. Parker. He says:

"When golden pippin trees are white
 Some mellow, liquid, notes are heard,
 That mingle in one brief delight
 The thought of man, the soul of bird.
 Sing on, my redbird! Strains that speak
 A tenderer hope than words can tell;
 The boor who named thee for thy beak
 Had never felt the witching spell
 Of wild-bird music, such as cleaves
 The crust of pride and wafts the soul
 From hate that blinds, and care that grieves
 To love-taught art's divinest goal."

—*Hoosier Bards*, p. 14.

The song period continues until the end of August and sometimes well into September (September 10, 1891). I found the nest and eggs April 18, 1888. Mr. J. O. Snyder found a nest with two fresh eggs at Waterloo, May 20, 1883. They frequently build their nests in shrubs, vines and young trees in towns. Several pairs build every year within the town of Brookville, sometimes in vines that drape the walls and screen the windows of residences. The spring of 1897 a pair attempted to nest in a yard adjoining mine, but their hopes were blighted, for, during a storm, a heavy wind blew the nest and eggs from the Syringa bush where it was built, and the birds did not attempt to rebuild. I first saw the female carrying the fibrous bark of a last year's morning glory vine from my yard to the nest May 16. These were hanging in a cherry tree, and after much pulling she would get a bill full and carry it to my neighbor's bush. The female did all the work. The male accompanied her every trip to or from the nest. While she collected the nest-material he flew to the top of a chimney, the tip of the lightning-rod, the topmost limb of an apple or fir tree, sometimes a hundred feet away, and poured forth a lively, joyous song in earnest appreciation of the efforts of his mate. She could not start towards the nest but he instantly darted to her side and escorted her all the way; then, flying to the top of the neighboring house, or to a telephone wire, while the female arranged her material, he rejoiced in whistling song. A gay beau is the male! He is afraid of soiling his bright, new coat. He carries the style and is the chief musician. He lets his mate bear the burdens and encourages her by his presence. Some men do not as well. For several years a pair has built in a Virginia creeper against the side of another neighbor's house.

Often two broods, and sometimes three, are reared in a summer. Mrs. Jane L. Hine informs me that a pair nested near that place three times in the summer of 1891. The female was sitting August

28. That day, and for two weeks after, she sang sometimes a great deal. July 13, 1896, I saw young which had just left the nest, and August 28, of that year, I found a nest containing three eggs. To one who has not visited the lower Ohio Valley, including the southern part of the valleys of the Whitewater and the Wabash, especially at a season when the trees are leafless, it would be difficult to convey any idea of the numbers of Cardinals that are to be found there. The rougher land, overgrown with second-growth or briers, and the waste land along streams, afford an abundance of shelter, which will probably remain. While the quantity of food—seeds, wild fruits and insects, added to the grains that are ungarnished or scattered by man—affords them a good living, in winter they come about our homes and feed upon the crumbs from the kitchen or pick up a share of the wastes from the barnyard. It is no unusual thing, at that season, to find from three to six pairs frequenting a comparatively small thicket in a favorable locality, while almost every brier patch or clump of bushes harbor a pair or two.

They are easily tamed and in many localities are much sought, for cage birds. In localities where I have been I do not think the practice of trapping them or robbing the nests of young birds is as common as it was some years ago. It should be discouraged by every one and the offenders prosecuted.

138. GENUS *HABIA* REICHENBACH.

***231. (595). *Habia ludoviciana* (LINN.).**

Rose-breasted Grosbeak.

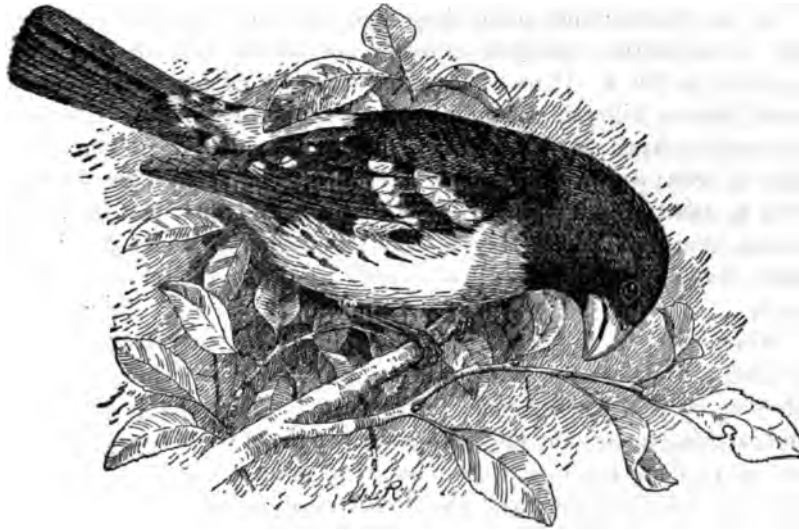
Adult Male.—Head, neck and back, glossy black; wings and tail, black, the former barred with white, and primaries white at the base, the latter with outer tail feathers tipped with white on inner web; breast and under wing coverts, bright rose-red or carmine; rest of under parts and rump, white; bill, large, pale; feet, dark. *Adult Female*.—Above, grayish-brown, streaked with cream-buff and blackish; stripe through center of crown, buff, and one over the eye, whitish; wing coverts, tipped with white; below, white, tinged with buffy and streaked with dusky; under wing coverts, saffron-yellow. *Immature*.—Similar to female, but with under wing coverts rose-red.

Length, 7.00-8.50; wing, 3.90-4.15; tail, 3.25-3.55.

RANGE.—America, from Ecuador to Labrador and Saskatchewan west to eastern Kansas. Breeds from higher points of North Carolina and central Indiana, north. Winters from Cuba and Mexico, south.

Nest, in bush, or low down in tree, of twigs, fibres and rootlets.
Eggs, 3-5; greenish-blue, thickly spotted with olive-brown and rufous-brown; .95 by .67.

Throughout northern Indiana this attractive bird is found, in most places, as a summer resident, increasing in numbers as one goes northward. Elsewhere, it is an irregular migrant, some years very common,



Rose-breasted Grosbeak.

(Beal.—Farmer's Bulletin 54, United States Department of Agriculture.)

others, rare or wholly absent. In some localities, where it was formerly found in some numbers, it is said to be becoming scarce.

It breeds commonly south to the Wabash River: Wabash, Logansport and Lafayette. Farther south, at Terre Haute, it rarely builds, and it has been reported nesting at Frankfort, Lebanon and Anderson. It is extremely unusual for it to breed farther south, but it has been so reported from Bloomington. Audubon found it nesting near Cincinnati, O., and Dr. R. Haymond thought it might breed in Franklin County, as he had found it there in early June and in August. Dr. Wheaton once found a nest near Columbus, O. (Birds of Ohio, pp. 346, 347), and Mr. Otto Widmann has observed it nesting at St. Louis, Mo., where it rears two broods in a season (Nehrling, N. A. Birds, Pt. XIII., p. 204). They nest on low bushes, tall shrubs, in orchards and forest trees even, at times quite high. Along the Des Plaines River, in Illinois, they nest in thorn trees (Parker). They prefer to breed in the neighborhood of lakes, streams and tamarack swamps

(Mrs. Hine). In northern Ohio, they frequent the cranberry marshes and nest there (Wheaton). The nest and eggs very much resemble those of a Scarlet Tanager.

The first nests, with full sets of eggs, are usually found late in May; May 22, 1897, Anderson; May 27, 1893, Lafayette; May 30, some years, Cook County, Ill. The breeding season continues through June. The male shares in incubation.

In the spring, some years, they come into the State by April 25, and arrive at their breeding grounds, beyond the Wabash River, by April 27 to May 1. Dates of early and late first arrivals for the places noted are as follows: Bloomington, April 23, 1886, May 1, 1887; Brookville, April 25, 1885, May 8, 1897; Bicknell, April 25, 1897, May 3, 1894; Spearsville, April 29, 1894, May 1, 1895; Terre Haute, May 1, 1887, May 9, 1890; Lafayette, April 28, 1894, May 8, 1897; Sedan, April 28, 1896, May 7, 1889; Petersburg, Mich., April 27, 1888, May 5, 1889. The earliest arrivals are males; the females follow later.

When with us, in southern Indiana, in spring, they frequent the wooded hillsides and uplands, preferring the former. There they are often to be seen feeding upon the buds of the elm, oak and maple, and catching insects among the topmost boughs of those trees. They do not move about much, but their beautiful notes attract one to them. Often, in looking among the greening tree-top, one may be seen, and, while watching it, another and another will move slightly until from six to a dozen are finally located.

Viewed from a distance through the timber, as they fly, they may readily be taken for Red-headed Woodpeckers, so sharply is the black and white of the plumage contrasted.

All who have heard the song of the Rose-breasted Grosbeak have been charmed by it, and all who have known the singer, hold it in the highest regard. Beauty of song has made it famous as a wild bird, and it is extensively known also as a desirable cage bird, but the beauty of its tri-colored plumage would attract attention even had it not such a remarkable voice. That is not all; it does beautiful deeds. Few birds are more beneficial to man. With the exception of a few peas, its vegetable food consists of the buds and blossoms of shade and forest trees, and seeds. They eat many insects. The value of its services in its breeding range, in destroying Colorado potato beetles, can not be overestimated. Prof. F. E. L. Beal tells of one field that was badly infested by these destructive insects. "The Grosbeaks visited the field every day, and finally brought their fledged young. The young birds stood in a row on the topmost rail of the fence, and were

fed with the beetles which their parents gathered. When a careful inspection was made, a few days later, not a beetle, old or young, could be found; the birds had swept them from the field and saved the potatoes" (Farmers' Bulletin No. 54, U. S. Dept. of Agr., p. 29). "Of eight specimens examined, six had eaten small seeds; two, seven beetles; and one, berries" (King, Geol. of Wis., I., p. 542). Prof. Forbes notes they eat canker worms, which, in some he examined, formed 66 per cent. of their food (Rept. Mich. Hort. Soc., 1881, p. 204); also army worms and other caterpillars, wood-boring, leaf-chafing and snout beetles, and hymenoptera.

The latest dates at which they have been observed, in fall, are as follows: Plymouth, Mich., September 3, 1894; Lebanon, Ind., September 12, 1894; Lafayette, September 15, 1894; Bicknell, September 28, 1894; Sedan, September 22, 1889; Warren County, September 18, 1897; Chicago, Ill., September 26, 1895; Brookville, Ind., October 5, 1887.

139. GENUS *GUIRACA* SWAINSON.

232. (597). *Guiraca cærulea* (LINN.).

Blue Grosbeak.

Adult Male.—Deep blue, darker on the back; chin, lores and tail feathers, black; wings, black, edged with blue; middle and secondary wing coverts, tipped with rufous-brown or chestnut. *Adult Female and Immature*.—Yellowish-brown above; brownish-yellow beneath; darkest on breast; wings and tail, fuscous; wing crossed by two bars of ochraceous-buff; tail, faintly tinged with blue.

Length, 6.35-7.50; wing, 3.35-3.60; tail, 2.70-2.90.

RANGE.—North America, from Cuba and Mexico to southern Nebraska, southern Indiana and South Carolina. Casually to New England. Winters south of the United States.

Nest, in bush, or low in tree, at edge of wood or field, of grass, lined with rootlets and hair. *Eggs*, 3-4; pale bluish-white; .84 by .66.

Of rare or accidental occurrence in the southwestern part of the State. Mr. Robert Ridgway observed a specimen in Knox County in the spring of 1881. That is the only record of its occurrence in Indiana. Mr. Ridgway notes it as rare in southern Illinois, and it has been observed in Kentucky. This species is quite local and inconspicuous. It frequents localities similar to those occupied by the Indigo Bunting. The song is said to resemble that of the Purple Finch. In summer they are said to live chiefly upon insects, but through fall and winter they subsist mainly upon wild fruits and seeds.

140. GENUS PASSERINA VIEILLLOT.

233. (598). *Passerina cyanea* (LINN.).*Indigo Bunting.**

Synonym, INDIGO BIRD.

Adult Male.—Blue; darker on head, throat and breast; lighter on back; black about base of bill; wing and tail feathers, black, with bluish edgings; bill, dark above, light below, with a dark stripe along gonys. *Adult Female*.—Brown above, whitish below, more or less streaked with brownish; shoulders, rump and some of larger feathers, showing blue; wing and tail feathers, more or less distinctly edged with bluish. *Immature*.—Male, similar to female, but showing more or less blue, according to age; young birds, streaked below.

Length, 4.75-5.75; wing, 2.60-2.80; tail, 2.20-2.50.

Note.—Close observation will show bluish edgings on wing and tail feathers, which will determine the bird.

RANGE.—North America, from Panama and Cuba, east of Plains, to Minnesota, northern Michigan and Nova Scotia. Breeds throughout its United States range. Winters from the coast of the Gulf States, south.

Nest, in crotch of bush, low down, of leaves, grass and bark, lined with similar material. *Eggs*, 3-5; white, tinged with blue, occasionally speckled with reddish-brown; .73 by .53.

The Indigo Bunting is a common summer resident throughout Indiana. The blue plumage and sprightly song of the male are known to every one who has spent much time about bushes, brier patches and thickets. They prefer the drier land and are very seldom found, in southern Indiana at least, about low or swampy places.

They sometimes appear on the southern border of the State by the middle of April, but other years, when the season is more forbidding, they are not found until May 1. The following early and late dates of first appearance are given: Bloomington, April 13, 1882, May 2, 1895; Bicknell, April 22, 1896, April 30, 1895; Brookville, April 22, 1885, May 8, 1889; Vigo County, April 18, 1897, May 8, 1886; Spearsville, April 27, 1895, and 1897, April 29, 1894; Greencastle, April 24, 1896, May 1, 1894 and 1895; Lafayette, April 27, 1896, May 10, 1895; Sedan, May 4, 1895, May 5, 1896; Chicago, Ill., May 18, 1895, May 23, 1896 and 1897.

The males precede the females from a day to a week. Mating begins soon after the latter arrive. The beginning of pairing was noted at Brookville, May 9, 1887. Sometimes they must be mated when

they arrive. Mr. V. H. Barnett found a nest, with two eggs, at Spearsville, May 14, 1895. They may be found nesting commonly late in May and early in June. Sometimes two broods are reared in a summer. August 18, 1896, I found a nest and eggs at Brookville. Mr. J. O. Snyder informs me he has known these birds to use the same nest two years in succession. The males continue in song well along toward the first of August. I found one singing, August 3, 1897. After they cease singing they are less conspicuous. They leave the latter part of August and in September. The old males go first. The latest dates at which they have been seen at the places noted are: Manchester, Mich., September 10, 1894; Plymouth, Mich., September 15, 1895; Sedan, Ind., September 27, 1894; Lafayette, September 21, 1895; Trafalgar, September 26, 1897; Bicknell, September 29, 1895; Brookville, October 14, 1896.

They are so numerous, frequenting every place where bushes grow about the farm, even to the small fruit garden, and can adapt themselves to many foods, that it is desirable that they receive the fullest protection, for at any time they may prove of untold value in assisting to hold in check some threatened outbreak of injurious insects. Prof. King found that, of 19, 2 ate caterpillars; 1, 2 beetles; 1, a grasshopper; 1, raspberries; 1, elderberries; and 18 of them ate seeds of various weeds (Geol. of Wis., I., p. 542). Prof. Forbes found that 78 per cent. of the food of some he examined was canker-worms (Rept. Mich. Hort. Soc., 1881, p. 204). He also notes they eat other caterpillars, spring beetles, vine chafers, snout beetles and hemiptera.

141. *GENUS SPIZA BONAPARTE.**234. (604) *Spiza americana* (GILL).

Dickcissel.

Synonyms, BLACK-THROATED BUNTING, LITTLE MEADOW LARK.

Adult Male.—Top and sides of head, sides and back of neck, ash; forehead, tinged with yellow; line over eye, one on each side of throat, edge of wing, and breast, yellow; a black patch on throat and upper breast; throat, lores, belly and under tail coverts, white; wing coverts, chestnut; back, with black streaks; wings and tail, fuscous. *Adult Female*.—Similar, except less yellow on the breast; black patch on throat replaced by spots or streaks; top of head, more brownish. *Young*.—Similar to female, but more buffy.

Length, 5.75-6.80; wing, 2.80-3.30; tail, 2.35-2.90.

RANGE.—America, from Colombia over the eastern United States to Massachusetts, Ontario, Michigan, Minnesota and North Dakota. Rare east of the Alleghanies. Breeds throughout its United States range. Winters south of United States.

Nest, on ground or in bush, of leaves, grass, rootlets and weed stalks, lined with grasses and hair. *Eggs*, 3-5; pale blue; .80 by .60.

In most localities the Dickcissel is an abundant summer resident. However, it is a recent introduction into our fauna. Mr. E. J. Chansler says he can remember when it was rare in Knox County, where its numbers now are perhaps exceeded by no other bird. It appeared in Franklin County some time between 1869 and 1879. While it has become abundant there, in the upland meadows, it is quite uncommon in the valleys of streams and on the rougher land. As is to be supposed, it is rare in the more heavily timbered portion of southern Indiana. In 1886, Prof. B. W. Evermann noted it was becoming more common in Carroll County each year. Mrs. Jane L. Hine first observed them at Sedan, Dekalb County, in 1887, and Mr. J. P. Feagler, at Waterloo, in 1894. They are still rare there. In the spring of 1887 I found it rare in the parts of Cook County, Ill., that I visited. It is now said to be locally common there. Dr. Gibbs says (1893) it was not known in Michigan twenty years ago (Cook, Birds of Mich., p. 118). In 1894 Mr. L. Whitney Watkins notes that it only appeared at Manchester, Mich., within the last few years. Mr. T. L. Hankinson noted that it appeared for the first time at Agricultural College, Mich., the spring of 1896. Prof. E. E. Fish, of Buffalo, N. Y., informed me that in 1891 it was more numerous than any other species of bird about Logansport, Ind.

Some early and late dates of first spring appearances are given: Brookville, April 19, 1887, May 10, 1886; Bicknell, April 20, 1894, May 13, 1896; Bloomington, April 28, 1893, May 4, 1895; Greencastle, April 29, 1893, May 5, 1896; Lafayette, April 27, 1896, May 13, 1893; Waterloo, April 30, 1897, May 10, 1896; Plymouth, Mich., May 1, 1895, May 3, 1891; Chicago, Ill., May 4, 1895, May 16, 1897.

They are associated in my mind with the Grasshopper Sparrow. They arrive about the same time, frequent similar places, the period of singing is about the same, and they depart together. In the southern part of the State they are often mated when they arrive. The site for a home is at once chosen and work upon the structure is begun. The bird is adapting itself to conditions. In the more open regions it nests upon the ground, frequently in a clover field or meadow. Other places, it builds in clumps of weeds a little distance off the ground. Dr. Hoy, of Racine, Wis., never found a nest in that

vicinity on the ground, and some were elevated on bushes as much as six feet. Prof. Cook says, in Michigan, they usually nest on bushes. In Lake County, Ind., Mr. L. T. Meyer notes that they nest upon the ground. The same conditions that operate upon the Grasshopper Sparrow act upon the Dickcissel. The different times of mowing the clover and timothy crops and of cutting the small grain result in driving them and the insects from the land, as they are left neither shelter nor their usual food. Notwithstanding these discouragements, they continue common, and our people are beginning to recognize in them good friends.

Mr. W. O. Wallace has taken a nest and four eggs in Wabash County as early as May 18, 1894, and Mr. T. L. Hankinson took a nest and four eggs at Agricultural College, Mich., June 18, 1896. Their song is a peculiar one, uttered from fence, bush, tree or tall weed, from early morning till evening. It is said to suggest the syllables *see, see—Dick, Dick-cissel, cissel*. Dr. Coues would interpret it: *look! look! see me here! see!* But it comes to me characteristically as five metallic sounds—something like the noise made by dropping six silver dollars, one upon the other, into one's hand: *clenk, clenk, clenk-clenk-clenk*. They keep singing until late July or early August, and then the song and the singer vanish together. Many were heard singing August 3, 1897. August 6 there were but few, and neither song nor bird were noted after that date. In 1896 they were last reported from Bicknell, August 26 (Chansler).

Prof. S. A. Forbes, in writing of an orchard infested with canker-worms, says: "Another valuable species was the Black-throated Bunting, *Spiza americana*. This confined itself less strictly to the (canker) worms for food than the foregoing (Cedar bird), but was much more abundant and was nesting in the orchard. Eleven birds were examined, and eight of them were found to have eaten canker-worms, which made about half the total food of the whole number. Caterpillars are usually eaten in May by the Black-throated Bunting, in the ratio of about 20 per cent., while they made 70 per cent. of the food of those shot among the canker-worms" (Rept. Mich. Hort. Soc., 1881, p. 204). They live largely upon grasshoppers and other meadow insects, eating also seeds.

XLI. FAMILY TANAGRIDÆ. TANAGERS.

α^1 . Bill stout, finchlike, with a more or less evident tooth near middle of cutting edge of upper mandible. PIRANGA. 142

142. GENUS PIRANGA VIEILLLOT.

α^1 . Male scarlet, wings and tail black; female not red, under parts greenish yellow.

P. erythromelas Vieill. 235

α^2 . Male vermillion red; wings and tail not black; female not red; buffy yellow below. **P. rubra (Linn.). 236**

*235. (608). **Piranga erythromelas VIEILLLOT.****Scarlet Tanager.****Synonym, BLACK-WINGED REDBIRD.**

Adult Male.—Head and body, continuous, intense scarlet; wings and tail, intense black; bill, greenish; feet, blue. *Adult Female*.—Olive-green above, greenish-yellow beneath; under wing coverts, white; wings and tail, fuscous. *Immature Male*.—At first, similar to female, but with wings and tail black; later, with plumage spotted with green and scarlet.

Length, 6.50-7.50; wing, 3.55-3.90; tail, 2.80-3.25; bill, .55-.60.

RANGE.—America, from Peru north over eastern United States to New Brunswick and Manitoba. Breeds from southern Illinois and Virginia north. Winters south of United States.

Nest, on a horizontal lower limb of tree, usually on the borders of a wood; of twigs, bark and leaves, lined with rootlets and bark fibres.

Eggs, 3-5; greenish-blue or bluish-white, speckled and blotched with rufous-brown; .90 by .65.

The brilliant red and jet-black plumage of the male Scarlet Tanager have made it a well known bird to those familiar with the more open woodland. Its less conspicuous mate is, however, a stranger. They are common summer residents throughout the State, arriving in southern Indiana late in April, the migrants passing rapidly through, and, in from three days to a week, usually reaching our northern border. The following are early and late dates of its first arrival: Brookville, April 22, 1882, May 1, 1884, and 1896; Bicknell, April 18, 1896, April 24, 1894, and 1895; Bloomington, April 22, 1896, May 6, 1882; Lafayette, April 25, 1896, April 30, 1895; Sedan, April 19, 1889, April 30, 1894; Laporte, May 2, 1893, May 9, 1896; Petersburg, Mich., April 27, 1888, May 6, 1893; Chicago, Ill., May 1, 1886, and 1896, May 11, 1894.

In the Whitewater Valley they frequent the wooded hillsides and uplands, being seldom found among the timber in the river bottoms.

In southern Illinois, according to Mr. Ridgway, they prefer the high timber of bottom lands to upland woods. In the northern part of the State the upland oak woods are favorite haunts.

Mr. Bicknell says their ordinary note is chip-chirr, but quotes Mr. F. T. Jencks as saying that, in Illinois and Indiana, it has three notes—chip-chir-ree. He notes that its song may be heard until August 20 (*The Auk*, Vol. I., 1884, p. 326). To me it seems to utter a *chuck-ah* or *chuck-ur*, which is one of the characteristic sounds of the woodland. The Scarlet Tanager has a song, too, which it sings from the top of some tree. Mr. Ridgway says this resembles "somewhat that of the Robin in its modulation, but is shriller in tone, more hurried, and enunciated in a peculiar, wavering style."

In spring, the males are observed in advance of the females, but usually only a few days at most. Mating follows at once upon the arrival of the latter. I observed them mating, May 4, 1886. May 15, 1897, one of my sons found an egg of this species on the ground, where it had in some manner been dropped. I found a nest, with eggs, May 20, 1886. The latter part of May and through early June nests may be found containing eggs. Their nest is a frequent receptacle for the egg of the Cowbird. Scarlet Tanagers begin to be less numerous in August, and generally leave before the middle of September. However, specimens have been observed at Chicago, Ill., October 3, 1895; Brookville, Ind., October 6, 1894; Zanesville, October 22, 1896; Lebanon, September 29, 1894.

They live principally upon insects and destroy great numbers of those kinds that frequent forest trees. Dr. B. H. Warren examined 29 specimens and found that, with the exception of two, which had eaten cherries, their food was entirely insects, largely beetles (*Birds of Pa.*, 2d Ed., p. 251). Prof. F. H. King also examined 29 specimens, and found their principal food was as follows: 26 caterpillars, 47 beetles, 11 spiders, 7 grasshoppers. They also had eaten ants, ichneumon flies, 6 diptera, 6 hemipterous insects, 1 dragon fly. Curculios, elaters and leaf-chafers formed a part of the beetles eaten (*Geol. of Wis.*, I., p. 512).

"At least three years seem to be required for the assumption of the perfect plumage of the male. In the first year the young male is like the female, but has black wings and tail; in the fall red feathers begin to make their appearance, and the following spring the red predominates in patches" (B. B. and R., *Hist. N. A. Birds*, I., p. 435). Occasionally, also, the female assumes, in part or wholly, the plumage of the male (*The Auk*, July, 1891, pp. 315, 316; *Ibid*, October, 1897, pp. 406, 407).

The correction in nomenclature by which the present species becomes *P. erythromelas* instead of *P. rubra*, which is the correct name of the Summer Red Bird, has led to much confusion, and many erroneous records have latterly been made by those using the old nomenclature.

***236. (610). *Piranga rubra* (LINN.).**

Summer Tanager.

Synonyms, SUMMER REDBIRD, RED BEE-BIRD.

Adult Male.—Vermillion-red, the wings and tail similar; other upper parts, duller than lower; bill, yellowish, darker above; feet, gray. *Adult Female*.—Yellowish-olive above, light ochrey-yellow beneath (Ridgway). *Immature*.—Like female.

Length, 7.45-7.95; wing, 3.70-3.95; tail, 2.90-3.15; bill, .82-.90.

RANGE.—America, from Peru over eastern United States to New Jersey, Indiana and eastern Kansas. Casually to Nova Scotia and Ontario. Breeds throughout its United States range. Winters south of United States.

Nest and Eggs, similar to those of *P. erythromelas*.

Over a good portion of southern Indiana the Summer Tanager is a common summer resident. It is not so brightly colored as the last species and is less retiring, being often found along highways, where they pass through woods, and about the edges of timber land. They frequent the more level upland, where, among the oak and beeches of the white clay land, they are more abundant than the Scarlet Tanager in the same portion of the State. They are common as far as Hanover, the bluffs of the Whitewater near Brookville, which river they rarely cross, Bloomington, and Terre Haute. They have been noted at Greencastle and at Shades of Death, Parke County. Mr. V. H. Barnett noted it near Clinton, Vermillion County, August 2, 1897. Mr. Robert Ridgway has noted its appearance at Wheatland from April 18 to 23. It has first appeared at other places noted at the following early and late dates: Bicknell, April 16, 1896, April 26, 1894; Hanover, April 21, 1896, April 27, 1897; Bloomington, April 28, 1886, May 1, 1893; Terre Haute, April 26, 1890, April 28, 1888; Brookville, April 26, 1897, May 11, 1880. In the fall, they leave late in September and early in October. The latest dates noted are Brookville, September 24, 1894; Bicknell, October 4, 1896; Wheatland, October 10, 1882.

The call note is different from that of the Scarlet Tanager, sounding, as it comes through the woods, like *per-chuck-urr*. Mr. Ridgway says its ordinary notes are pa-chip-it-tut-tut-tut, or, as Wilson expresses it, chicky-chuck-chuck. The song resembles, in its general character, that of the Scarlet Tanager, but is far louder, better sustained and more musical. It equals in strength that of the Robin, but is uttered more hurriedly, is more wiry, and much more continued. The male does not acquire his full plumage for several years. Therefore, the plumage is often strangely marked with red and yellow. Females are sometimes found showing red markings. "One, shot at Wheatland, Ind., May 21, 1881, had the plumage more than one-half red, the red color being of greater extent, in fact, than on the male, which was killed by the same shot. The tint of red is very peculiar, being of dull Chinese orange, instead of pure, rosy vermillion, as in the male. * * * The food of this bird consists, to a great extent, of hornets, wasps, and bees, on which account it is to a greater or less extent known to the farmers as the 'Red Bee-bird' " (Ridgway, Birds of Ill., I., pp. 217, 218). These and other insects constitute its summer food, but with the ripening of wild fruits and seeds in the fall, they become quite a factor in its bill of fare.

To most of us this bird was formerly known as *P. æstiva* (Gm.), and to the last species was given the name *P. rubra* (Linn.). It was found that Linnaeus' name, *rubra*, applied to this species, and, in attempting to correct an error, much trouble has been caused to those who knew them by the old names, and, in regions where both are found, confusion of data will result.

XLII FAMILY HIRUNDINIDÆ SWALLOWS

*a*¹. Nostrils opening directly upward and with very little membrane bordering edge.

*b*¹. Wing 5.00 or more; tail forked; male glossy black. PROGNE. 143

*b*². Wing less than 5.00; tail nearly even.

*c*¹. Plumage of upper parts lustrous blue-black, marked with various shades of chestnut; edge of outer quill without recurved hooks.

PETROCHELIDON. 144

*c*². Plumage of upper parts pale grayish brown; edge of outer quill with stiff recurved hooks (obscure in female).

STELGIDOPTERYX. 148

*a*². Nostrils opening laterally, covered more or less by a membrane or scale.

*d*¹. Tail forked for more than half its length; tail feathers with white spots.

CHELIDON. 145

*d*². Tail forked for less than half its length.

*e*¹. No feathers on lower part of tarsus; plumage lustrous above.

TACHYCINETA. 146

*e*². Small tuft of feathers on lower part of tarsus; plumage of upper parts dark gray.

CLIVICOLA. 147

143. GENUS PROGNE BOIE.

237. (611). Progne subis (LINN).*Purple Martin.**

Adult Male.—Lustrous blue-black. *Adult Female and Young*.—Much duller above; more or less white below, streaked with gray.

Length, 7.25-8.50; wing, 5.65-6.20; tail, 3.00-3.40.

RANGE.—America, from Argentine Republic and Bolivia north over eastern United States to Manitoba, Ontario and Newfoundland. Breeds throughout its range. Winters from Mexico, south.

Nest, of grass, straw, string, paper, etc., lined with feathers; in boxes provided for them. *Eggs*, 4-5; pure glossy-white; .97 by .72.

The Purple Martin is a well known summer resident in most localities. Some places, however, it is not found, though common a few miles away. In many localities its numbers are much less than formerly, while in a few places it is noted as becoming more common. None of our native birds have suffered more from the English Sparrow than this. Their houses, homes in box cornices, and other nesting sites, have been occupied by the irrepressible little foreigner. The Martins fought bravely for their homes, but in many cases gave up the battle. In southeastern Indiana they are notably few in numbers, compared with those that summered there before the Sparrows came. This is true about all the cities and larger towns, not of this State only, but of the eastern United States generally. At Lafayette, I am informed, they were more common in 1896 than usual. In DeKalb County it is rare (Mrs. Hine), and is not found at Waterloo (Snyder) or at Redkey (Hathaway). I suspect, from the fact that they regularly return each spring, they will adapt themselves to circumstances and once more become numerous. This could be helped by our having boxes prepared that could be put up about the time they appear or at a moment's notice when they arrive. These sites would not then be occupied by Sparrows in advance, and, with a little watchfulness upon our part the Martins would probably be secure in their occupancy of them. They would be further encouraged by keeping their houses closed each year until the time of their arrival.

The early and late records of first arrival are: Spearsville, March 21, 1894, March 29, 1897; Brookville, March 27, 1882, April 16, 1894; Bloomington, March 28, 1886, April 17, 1895; Bicknell, April 6, 1894, April 12, 1895; Greencastle, April 2, 1893, April 12, 1894; Lafayette, March 23, 1897, April 30, 1893; Richmond, March 25, 1897; Muncie, April 3, 1897, April 28, 1893; DeKalb County, April 5, 1896, April 17, 1894; Laporte, April 4, 1893, April 14, 1894; Peters-

burg, Mich., April 26, 1888, May 1, 1889; Chicago, Ill., March 31, 1885, May 5, 1896. The males often arrive first and are followed later by the females.

Mating begins early in April, or at once upon arrival, if they are late. In 1896, Prof. W. P. Shannon noted that they began to build at Greensburg April 25. May 9 the nest was completed and the first egg was laid. Evidently an egg was deposited each day, for on May 13 the nest contained four eggs, and the bird had begun to sit. The young are usually able to leave the nest toward the last of June. I observed them learning to fly in 1886, from June 28 until July 9. After the young are able to fly, neither the old nor young return to the nesting site to roost.

Mr. Otto Widmann tells us, as night falls they collect in colonies in willow thickets, where they roost, and scatter again as the day breaks. Their cheery songs are heard well into July—July 21, 1897. Mr. Widmann noted them singing at St. Louis, Mo., as late as August 12. Their ordinary call is heard as long as they remain. They were last observed, at Lafayette, August 31, 1896, and September 19, 1895; at Bicknell, August 18, 1896, August 30, 1894; Vermillion County, August 14, 1897; Brookville, August 31, 1883. Often they mostly disappear late in July or early in August, and usually but few are seen after the middle of the latter month.

The Martin is a general favorite, yet it destroys many bees, tiger beetles and other beneficial insects. Therefore it should eat a great quantity of injurious insects to balance the destruction of those beneficial kinds. Prof. King informs us that five ate 14 bees, 8 tiger beetles, 2 butterflies, 9 breeze flies, 6 dragon flies, 3 mollusks (Geol. of Wis., I., p. 24). They have also been known to capture squash beetles.

The Purple Martin migrates from tropical America, both north and south, breeding in the Argentine Republic as naturally as it does with us. Prof. F. Sumichrast reported it a resident of the Alpine region of Mexico.

141. GENUS PETROCHELIDON CAPANIS.

*238. (612). **Petrochelidon lunifrons** (SAY.).

Cliff Swallow.

Synonyms, EAVE SWALLOW, SQUARE-TAILED BARN SWALLOW, MUD DAUBER.

Adult.—Lustrous steel-blue; forehead, whitish or brown; rump, rufous; chin, throat and sides of head, chestnut; a steel-blue spot on the throat; breast, sides and generally a ring around the neck, rusty-gray, whitening on the belly. *Immature*.—Duller; throat, black, possibly with whitish markings.

Length, 5.00-6.00; wing, 4.05-4.55; tail, 2.00-2.20.

RANGE.—America, from Paraguay to Labrador, Alaska and the Arctic Ocean. Breeds from Mexico (Mazatlan), north. Winters south of the United States.

Nest, a bottle or gourd-shaped structure of mud, attached to cliffs or under the eaves of buildings, lined with feathers and bits of straw. *Eggs*, 3-5; white, spotted with olive or rufous-brown; .81 by .55.

One of the pleasant recollections of my boyhood is of visits to the country where the large barns were elaborately decorated beneath the eaves, sometimes in a double row, with the curious, bottle-shaped nests of the Eave Swallow. I should think from one to two hundred nests could be found on a single barn, and many barns harbored large colonies. Now they are much less common in Franklin County. In southern Indiana they prefer the uplands for building sites, usually nesting in colonies. Sometimes, however, one, or a few pairs, are found nesting by themselves. They usually return year after year to the same building, but occasionally change the site of a colony, deserting an old locality and seeking a new one. They now rarely build along our rivers, though I can remember when some barns there were quarters for large numbers. That would seem to be the natural place for their homes because of the ease with which mud can be obtained. But the sand in the mud is a discouraging feature that is responsible for so few nesting there. I know of two instances in which a colony of these birds came to a barn near the river and began to construct nests. When they were almost completed they crumbled and fell. Again and again they tried to build, but each time the nests fell when they began to dry. At last, despairing of succeeding, they left the locality never to return. I know of but one instance of their building in a town. Some years ago I found a few pairs nesting about a barn near the canal at Metamora, Ind. Before the days when men built barns these birds built along cliffs. In some parts of the United States such sites are still occupied. Mr. Angus Gaines informs me they yet breed against a bluff in Knox County. In the days gone by the thoughtless farmer, with his long pole; the mischievous urchin and the prowling cat were their most persistent enemies. Later man introduced the English Sparrow, which in many localities has succeeded in driving the "mud daubers" away. Each year reports are made of additional localities from which they have been driven. In 1891 they and the Barn Swallows were driven from our barn by English Sparrows (S. T. Sterling, Camden). In 1895 none appeared at Bicknell; seldom nests any more (E. J. Chansler). Decreasing in numbers within the last year, 1897 (Prof. Glenn Culbertson, Hanover). Are being

driven off by English Sparrows (A. H. Kendrick, Ellsworth, 1897). Not so common as formerly; has been driven off by English Sparrows (Wabash, Ulrey and Wallace).

The impression once held was that these birds had but recently extended their range to the eastern United States. It is known, however, that they were found in New York, New Hampshire, New Brunswick and Vermont about the time the species was described by Say. In 1819 Audubon noted them at Newport, Ky. Information concerning their occurrence in this State prior to 1850 is almost wanting. Dr. Haymond says: "These Swallows first built their nests in this county (Franklin) in 1849. Previous to that time they were occasionally seen as migrants" (Proc. Phila. Acad. Sci., 1856, p. 287). In the early days when they built about cliffs they were unknown, save during migration, away from the vicinity of such places. Their extension over the State, and over the country generally, came with the provision by man of suitable nesting sites.

Mr. Geo. L. Toppan informs me that he found two nests among a colony of these birds, each of which was of the usual gourd shape, and contained an egg of the Cowbird. It seems impossible that these intrusive eggs could be deposited in such nests except the parent Cowbird placed them there with her bill.

The Cliff Swallow some years arrives by April 10; others, is nearly a month later. Early and late dates of first arrival are: Brookville, April 12, 1881, April 26, 1897; Bloomington, April 18, 1884, May 2, 1893; Hanover, April 10, 1897, April 24, 1896; Delphi, April 7, 1894; Vigo County, April 15, 1896, April 26, 1897; Dekalb County, April 10, 1897, May 4, 1890; Michigan City, April 12, 1890; Petersburg, Mich., April 26, 1889; Chicago, Ill., April 13, 1886, May 9, 1897. Sometimes not only the early arrivals, but late ones as well, perish from severe weather. During the very unseasonable weather of May 20 and 21, 1883, many died. After breeding they leave the vicinity of our homes, but later in the season, generally in August, are seen again as they make their way southward. The latest fall dates at hand are: Bicknell, August 25, 1896, September 5, 1894; Franklin County, September 3, 1897; Sedan, October 5, 1887. They feed upon insects, among which have been identified ichneumon flies, flies, leap-hoppers, beetles, bugs, ants, wasps and grasshoppers.

115. GENUS CHELIDON FORSTER.

239. (613). *Chelidon erythrogaster* (Bodd.).*Barn Swallow.****Synonym, FORKED-TAILED BARN SWALLOW.**

Adult.—Above, lustrous steel-blue; below, rufous or pale chestnut of varying shade; forehead, chin and throat, deep chestnut; breast, with an imperfect steel-blue collar; tail, with white spots on the inner web of all the feathers, except the inner pair; tail, deeply forked. *Immature*.—Less lustrous above; paler below.

Length, 5.75-7.75; wing, 4.60-4.90; tail, 3.70-4.10.

RANGE.—America, from southern Brazil north to Greenland and Alaska. Breeds from Mexico north. Winters in tropical America.

Nest, bowl-shaped; of mud and straw, lined with feathers, fastened by one side to timbers in a barn or to walls of a cave. *Eggs*, 3-5; white, spotted with olive and rufous-brown; .77 by .54.

The Barn Swallow is an abundant summer resident. It is not found in colonies as is the preceding species, but frequents barns, outhouses and old buildings in country and also in towns. There it builds inside buildings, usually a single pair occupying a building. Formerly it, too, nested in caves and in sheltered places against cliffs, but has adapted its life to the changed conditions.

Some years they arrive in southern Indiana before March is over, but that is unusual. Earliest and latest dates of first arrival are: Brookville, March 30, 1884, and 1887, April 23, 1893; Bicknell, March 31, 1897, April 19, 1894; Spearsville, April 5, 1897, April 19, 1895; Edwards, April 2, 1897; Camden, April 20, 1896, May 2, 1894; Sedan, April 17, 1896, April 29, 1895; Laporte, April 10, 1893, April 14, 1896; Petersburg, Mich., April 11, 1889, April 18, 1888. As with some of the other Swallows, they may be found along quiet stretches of river or about ponds and other bodies of water quite early. These are, doubtless, migrants. Often the summer residents do not appear about their breeding places until after May 1. Thus one station near a pond or lake will report migrants almost a month ahead of another but a few miles from water. They, too, are destroyed by storms. That of May 20 and 21, 1883, killed many. I found them mating April 21, 1881, and May 13 of that year found the nest with eggs. They often rear two broods and occasionally three. Before leaving, in August, they sometimes collect in considerable flocks. Usually they depart by August 20, but sometimes after all appear to have gone, migrants from

farther north appear in numbers. The following are the latest dates at which they were seen: Plymouth, Mich., August 29, 1894, September 4, 1886; Sedan, Ind., August 24, 1889; Lafayette, September 6, 1894; Vermillion County, August 31, 1897; Brookville, September 1, 1885, September 2, 1887; Bicknell, September 29, 1896.



Barn Swallow.

(Beal.—Farmer's Bulletin 54, United States Department of Agriculture)

Prof. King found 11 had eaten 14 small moths, 40 flies (among them 33 tipulids), 6 beetles and 1 dragon fly. Prof. Forbes' investigations show similar results. Many people have learned to prize these well-known birds, and still many others have not. Their value is great, for their service to mankind is great, and they are almost unobjectionable. The dollars they save in their warfare against insects entitle them to our thought as to means for their protection and encouragement. Openings should be left in the gables and high up on the sides of barns and other buildings and shelves or other projections provided on the outside that they may be attracted to our homes and farms.

146. GENUS TACHYCINETA CARANIS.

240. (614). Tachycineta bicolor (VIEILL.).*Tree Swallow.**

Synonym, WHITE-BELLIED SWALLOW.

Adult.—Above, lustrous green or steel-blue; below, pure white.

Immature.—Less glossy.

Length, 5.00-6.25; wing, 4.50-4.80; tail, 2.30-2.50.

RANGE.—North America, from Guatemala to Labrador, Great Slave Lake and Alaska. Breeds from Virginia, southern Indiana and Colorado north. Winters from South Carolina south.

Nest, in a hole in tree or stub; of leaves and grass lined with feathers.

Eggs, 3-7; white; .75 by .52.

The Tree Swallow is generally a migrant southward, but in the lower Wabash Valley and in northern Indiana it is a summer resident locally in suitable places. In some localities it is rare and in others very abundant. It doubtless formerly bred where the conditions were favorable throughout the State. Mr. E. R. Quick recalls having seen Swallows years ago in Franklin County, occupying holes in trees, in summer, which he now is satisfied were this species. They were also seen there as late as June 2, 1884. Mr. Robert Ridgway informs me that when he lived at Mt. Carmel, Ill., some years ago, this Swallow "was one of the most abundant summer residents, decidedly the most numerous of the family, breeding in very large colonies in sloughs connected with the river, their nests being invariably built in abandoned Woodpeckers' holes in dead stumps and trees. They were confined to the bottom lands. It was particularly numerous immediately above the dam at the Grand Rapids, about two and a half miles above Mt. Carmel, where a great number of large trees had been killed by raising the water level following the completion of the dam. I have no reason to suppose it does not still breed there wherever there are suitable places."

It breeds along the Kankakee River, where it is reported from English Lake (Deane) and Porter County (Parker). Also in Dekalb County (Mrs. Jane L. Hine, Snyder). This species winters in numbers regularly along the Gulf Coast. It is the first Swallow to arrive at its breeding grounds in the spring, often appearing before the ice is out of the rivers and lakes, and the last to leave in the fall. However, where it is only known as a migrant its appearance is very irregular and it is usually rare, appearing nearly always later than it does at

its summer home farther north. They have been first noted at Brookville, April 1, 1889, and April 25, 1892; English Lake, March 18, 1894, abundant; Laporte, March 19, 1894, May 1, 1896; Chicago, Ill., March 22, 1884, April 14, 1894. In the fall most of them leave by early September, but sometimes they remain later. They are recorded from Plymouth, Mich., September 3, 1894; Chicago, Ill., September 28, 1894; Bicknell, Ind., September 4, 1895. Mr. J. G. Parker, Jr., notes them at Chicago, Ill., as late as October 18.



Tree Swallow.

From its habit of building in holes in trees, being the only species that selects such sites, it is called "Tree Swallow." It has clung closely to its original nesting habit. Yet, occasionally, it is known to appropriate a Martin box, or to build under the eaves, or in some other favorable place about a building. We may expect them eventually to change their nesting habit. They prefer to nest in the vicinity of water, but do not always do so.

Fourteen specimens examined had eaten 63 beetles, a number of which were weevils; 33 small dragon flies, 22 winged aphidæ, or plant lice; 10 diptera, including ants and crane flies; 5 hymenoptera, 2 grasshoppers and one spider (King, Geol. of Wis., I., pp. 515, 516). The habit of this species, as well as of the two Swallows last mentioned, of skimming the grain fields shows the insects infesting such places constitutes much of their food.

147. GENUS CLIVICOLA FORSTER.

***241. (16). Clivicola riparia (LINN.).**

Bank Swallow.

Adult.—Above, lustreless gray, with a band of same across the breast; remaining under parts, white; small tuft of feathers above the hind toe. *Immature.*—Tinged more or less with rusty or whitish.

Length, 4.75-5.50; wing, 3.70-4.25; tail, 2.10-2.25.

RANGE.—America, from Brazil to Labrador and Alaska. Breeds locally from southern United States north. Winters from coast of Gulf States south.

Nest, in hole which it excavates in a steep bank. Generally nest in colonies. *Eggs*, 4-7; pure white; .71 by .50.

Abundant summer resident, breeding in colonies wherever there are steep banks along streams or about ponds in which they can excavate holes for their nests. In more level localities they sometimes dig holes in railroad and other embankments, where they are built of sand. Where desirable nesting sites are lacking, the Swallows are wanting and are only seen during migrations.

Late in March or early in April, some years, they may be found about water or near a sandy or loamy bluff. Other years they are about three weeks later in arriving. Five of them arrived at Lafayette, March 20, 1897, and in 1896 the first were seen April 25. The first arrived at Brookville, April 3, 1884, April 27, 1893; at Bloomington, April 6, 1884; Greencastle, April 13, 1893, April 27, 1896; Edwards, April 18, 1896, April 21, 1897. At Chicago they arrived from April 20 to May 10 (Parker). Mr. D. C. Ridgley found them building a nest near Delphi, April 28, 1894. They have been noted breeding near Chicago, Ill., June 17, 1894. The nests are placed at the end of galleries dug in the banks. Sometimes these excavations branch or have lateral passages, and in these two, or even more, pairs build nests.

When the young are old enough to leave the nest, they and the parents may be observed sitting on bushes or the limbs of brush along the stream. A favorite site is a telegraph wire. Where such are available, a little later, they may be found thickly strung along the wire associated with other kinds of Swallows. These Swallows have continued to nest in their old way. All other species found in the eastern United States have changed to a greater or less degree. Their white underparts, marked with a dark band across the breast, distinguish them when on the wing from the Rough-winged Swallow which occupies similar locations. They leave through the month of August, being rarely found in September. Observed abundantly at Chicago, Ill., August 4, 1896; Brookville, Ind., September, 1885, September 1, 1886; Mr. E. R. Quick reported them from Brookville, October 18, 1880. Its food consists of small flying insects, which it captures while skimming the water or flying low over the meadows and grain fields.

148. GENUS STELGIDOPTERYX BAIRD.

242. (617). Stelgidopteryx serripennis (Aud.).*Rough-winged Swallow.**

Synonym, BANK SWALLOW.

Adult.—Above, lustreless brownish-gray; quills and tail feathers, dusky-brown; below, light gray, whitish on belly and crissum; the edge of the wing supplied with small hooks, which are rough to the touch; no tuft of feathers above the hind toe. *Immature*.—With more or less of rufous tinge; lacking small hooks on the edge of wing.

Length, 4.75-5.50; wing, 3.70-4.25; tail, 2.10-2.25.

RANGE.—North America, from Panama to Connecticut, southern Ontario, Michigan, southern Montana and British Columbia. Breeds throughout its range. Winters from South Carolina and Mexico south.

Nest, in a burrow which it excavates in a steep bank, in openings in walls, in cavities about bridges and buildings and in old buildings; of grass or feathers. *Eggs*, 4-8; white; .75 by .53.

The Rough-winged Swallow is a summer resident throughout the State, frequenting principally such places as the Bank Swallow loves. It is, however, not so numerous as that well-known species. In the northern part of the State it is rare, and in many localities wanting. Because of the general lack of metallic lustre to the upper plumage, they are not usually distinguished. But this species may be known by its grayish throat and breast. While they breed together, excavating burrows in the same bank, I have observed that the single holes away from the colony contained nests of the present species. They also nest in open joints in masonry, the foundations of buildings, mortises, holes in the sides of buildings and even within buildings, where the nest is placed on a beam. Dr. Rufus Haymond was one of the first to call attention to the Rough-winged Swallow beginning to change its nesting habits (Field and Forest, Vol. I., 1876, p. 88; also, E. Coues, Bulletin Nutt. Orn. Club, Vol. I., 1876, p. 96, and American Naturalist, Vol. X., 1876, pp. 492, 493). The Bank Swallow has never attempted to find a better nesting site than a sandy bank.

I have found them mating as early as April 25, 1881. Prof. B. W. Evermann found nests nearly completed at Gosport, May 8, 1886. Dr. F. W. Langdon says: "Of a dozen or more nests of this species, taken at Madisonville, O., May 20-21, 1879, those from inland situations (along creeks and bridges) were complete in number (5 to 7) and well

advanced in incubation; while those from river banks were, with one or two exceptions, incomplete, containing only from one to four eggs, which in all cases were fresh (Journ. Cin. Soc. Nat. Hist., December, 1881, p. 338). Under the article on Belted Kingfisher, I have given Dr. Langdon's account of a burrow of each of these birds that was occupied by Humble Bees.

The times of their migrations correspond with those of the Bank Swallow and, unfortunately, but few persons have distinguished them to note their movements carefully. They first arrived at Brookville, April 3, 1888, April 27, 1895; Terre Haute, April 15, 1888, April 19, 1890; Greensburg, April 27, 1895, April 28, 1894; Irvington, April 11, 1889; Bloomington, May 1, 1886; Chicago, Ill., May 9, 1896. In addition, they have been reported from Carroll County (Evermann); Lafayette, nests (Dr. E. Test); Knox County (Ridgway); Jefferson County (Hubbard); Lake County (Coale); Wabash County, rare (Ulrey and Wallace). Their general habits are similar to those of the Bank Swallow, and they are of the same utility as insect-catchers.

XLIII. FAMILY AMPELIDÆ. WAXWINGS, ETC.

α^1 . Plumage cinnamon-drab; black stripe across forehead and through eye; secondaries often tipped with red wax-like appendages. AMPELIS. 149

SUBFAMILY AMPELINÆ. WAXWINGS.

149. GENUS AMPELIS LINNÆUS.

α^1 . Wing over 4.00.

A. garrulus Linn. 243

α^2 . Wing under 4.00.

A. cedrorum (Vieill.). 244

243. (618). *Ampelis garrulus* LINN.

Bohemian Waxwing.

Adult.—With a conspicuous crest; forehead, stripe through the eye, chin and upper throat, black; general color, brownish-ashy, tinged with reddish on the front of crown; rump, upper tail-coverts and secondaries, ashy; stripe on side of throat, and two short bands on wing, white; tips of outer web of most of the primaries, white or yellow; secondaries, with red wax-like tips; primaries, black; tail, blackish toward the end, but tipped with yellow; lower tail-coverts, cinnamon-rufous.

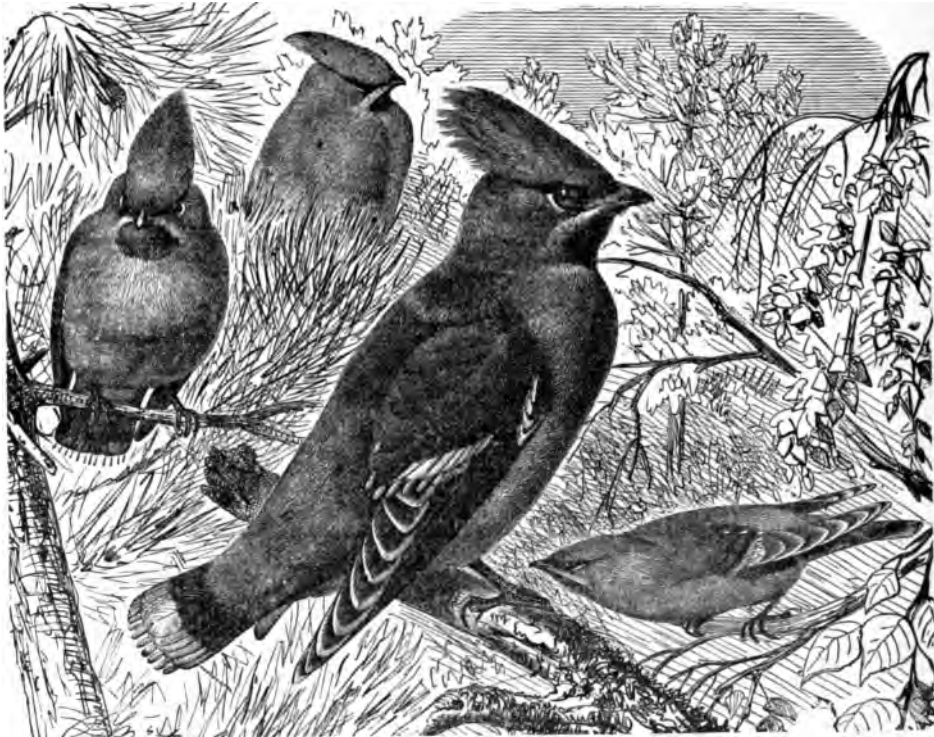
Length, 7.40-8.75; wing, 4.40-4.60; tail, 2.75-2.90.

RANGE.—Northern portions of northern hemisphere in America; south in winter, irregularly to Pennsylvania, Indiana, Illinois, Kansas,

Colorado, Arizona and California. Breeds north of the United States.

Nest, in trees; of twigs and rootlets. *Eggs*, similar to those of *Ampelis cedrorum*, but larger; .96 by .68.

This large Waxwing is an irregular winter visitor to northern Indiana and casually farther south. I am informed by Mr. J. E. Beasley, of Lebanon, Ind., that about forty years ago (1856), when he was liv-



Bohemian Waxwings. Reduced.

ing in Indianapolis, one spring he took nineteen Bohemian Waxwings in one day near that city. They were in a flock and were flying forward and backward over White River, catching insects after the manner of Flycatchers.

Mr. E. W. Nelson says they were unusually numerous in Cook County, Ill., the winter of 1875-6, remaining in that vicinity until March 15, 1876 (Bulletin Essex Inst., Vol. VIII., 1876, p. 103). It was noted in northern Ohio in March, 1840; July 17, 1845; 1860 (Wheaton, Birds of Ohio, p. 295).

The winter of 1879-80 they appeared in Indiana, Illinois and Michigan in numbers. Prof. S. A. Forbes reported them from Villa Ridge, Pulaski County, Ill., December 18, 1879 (Bulletin Nutt. Orn. Club,

Vol. V., p. 118). Dr. J. L. Hancock informs me that March 1, 1880, he shot two from a flock of eight that were feeding on mountain ash berries in Chicago, Ill. March 30, 1880, over one hundred of these birds were killed at Whiting, Lake County, Ind., and taken to a Chicago taxidermist. They were seen by Mr. H. K. Coale. Specimens from that lot are in the collections of Mr. H. K. Coale, Mr. Geo. L. Toppan and my own. Mr. C. A. Stockbridge, in 1889, informed me that "About ten years ago" (perhaps the winter of 1879-80) "three specimens were shot near Fort Wayne. Two of these are in the collection of Prof. H. Duemling, at Fort Wayne and the third in my own." Mr. Stockbridge has very kindly placed his specimen in my collection. Prof. B. W. Evermann is certain he saw a flock of a half dozen in the cedar trees in his father's yard, in Carroll County, several years ago (*The Auk*, January, 1889, p. 26). Messrs. Ulrey and Wallace say there is a specimen in the collection of Mr. M. L. Galbreath, at Collamer, that was taken near the Wabash County line (*Proc. Ind. Acad. Sci.*, 1895, p. 155). They are larger than the Cedar Birds, but resemble them in appearance and habits.

Mr. F. M. Woodruff, of Chicago, Ill., writes me that several Bohemian Waxwings were killed January 1, 1896, from a flock of fifteen or twenty at Lake Forest, Ill. Two days later another one was taken near the same place.

***244. (619) *Ampelis cedrorum* (VIEILL.).**

Cedar Waxwing.

Synonyms, CEDAR BIRD, CHERRY BIRD.

Adult.—Conspicuously crested; forehead, chin and stripe through the eye, black, the latter bordered above and the black forehead behind with white; lower eyelid and stripe on each side of the throat, white; general color, grayish-brown; tail-coverts and wings, ashy; tail, blackish toward the end and tipped with yellow; secondaries, and sometimes the tail feathers, with red, wax-like tips; belly, yellowish; lower tail-coverts, white. *Immature*.—More grayish, with indistinct whitish streaks; chin, not black; belly, dingy whitish; no red, waxen tips.

Length, 6.50-7.50; wing, 3.60-3.90; tail, 2.30-2.60.

RANGE.—North America, Honduras and Jamaica to Labrador and fur countries. Breeds from Florida, South Carolina, Virginia, Kentucky and Arizona north. Winters from Dakota, Minnesota, Michigan and Ontario south.

Nest, in tree, five to twenty-five feet up, or bush, in orchard, lawn, grove, etc.; of twigs, bark, leaves, etc., lined with grass and hair. *Eggs*, 3-5; bluish-gray, or stone-color, more or less distinctly spotted with black and dark-brown; .87 by .61.

Except during the breeding season, the Cedar Waxwings are gregarious, wandering about the country in flocks, usually of six to twenty-five, sometimes of a hundred or more. They roam at will, being abundant or scarce in a locality as food is plentiful or scanty. They are resident throughout the State, but vary in numbers, being generally most numerous northward in summer, from early May until October, and southward in winter and during the migrations.



Cedar Bird.

They are late breeders, nesting through June, July and August. They share this late nesting season with the American Goldfinch. Cedar Waxwings are known as Cherry Birds from their frequent visits to the early cherry trees, and after the early cherries are gone they begin to think about nesting. The nest is usually placed in small trees, bushes and shrubs. They build in the fruit trees in our orchards and yards and in the shade trees along the streets of our towns.

Mr. L. T. Meyer informs me of taking its nest and five eggs in Lake County as early as June 1. Mr. J. O. Snyder took a nest and four eggs in Dekalb County, June 27, 1885. I found young at Brookville unable to fly July 8, 1897, and a few weeks later—July 30—found another set of young barely able to fly. Rev. J. F. Clearwaters took a nest containing four fresh eggs near Michigan City, August

14, 1891. It was built in a huckleberry bush, six feet up. Its outside diameter was 5.50 inches; inside, 5.00 inches; inside depth, 2.00 inches. It was composed of grass and small twigs, lined with grapevine bark, "old man" moss and lichens. In fall and winter wild fruit, berries and seeds form much of their food. In winter nothing attracts them so much as the hackberry (*Celtis occidentalis*). Some years, early in spring, they are found living upon redbuds. Prof. F. E. L. Beal reports that of 152 stomachs examined, animal matter constituted 13 per cent. and vegetable matter 87 per cent. of the food. Except a few snails, all the animal food was insects, most of which were noxious. Of the vegetable food, 74 per cent. was wild fruit or seeds, and 13 per cent. cultivated fruit, including raspberries and blackberries, which may or may not have been cultivated kinds. The Cedar Waxwing is shown to feed its young almost exclusively upon insects. Of cherries it eats only the early kinds, and them not so extensively as has been supposed. From the fact that its food is so varied, it possesses the power to become a valuable bird in an emergency which may be caused at any time by an insect outbreak. Prof. S. A. Forbes has shown that in an orchard infested with canker-worms, the most useful bird was the Cedar Bird, about 30 of which had apparently taken up their residence in the orchard and were feeding entirely on the worms. The number in each stomach, determined by actual count, ranged from 70 to 101, and it was usually nearly 100. These 30 birds were, therefore, eating the pests at the rate of 3,000 a day, or 90,000 for the month during which the caterpillar is exposed to their attacks (Rept. Mich. Hort. Soc., 1881, p. 204).

They have a peculiar, lisping note, uttered in a monotone varying in pitch. As they sit among the branches of an Early Richmond cherry tree in early June, the note seems to be inhaled, and reminds me of a small boy who, when eating juicy fruit, makes a noise by inhalation in endeavoring to prevent the loss of the juice and then exclaims, "How good!" As the birds start to fly, each repeats the note three or four times. These notes develop into a song as the summer comes on; a lisping and peculiar song that tells that the flocks are resolving into pairs as the duties of the season press upon them.

XLIV. FAMILY LANIIDÆ. SHRIKES.

a¹. Color above ashy to ashy-blue; black stripes on sides of head. LANIUS. 150

150. GENUS LANIUS LINNÆUS.

a¹. Wing more than 4.25; feathers at base of upper mandible not black.

L. borealis Vieill. 245

a². Wing under 4.25; feathers at base of upper mandible black.

b¹. Above deep lead color; the upper tail coverts varying from near the color of back to nearly pure white.

L. ludovicianus (LINN.). 246.

245. (621). *Lanius borealis* VIEILL.

Northern Shrike.

Synonym, BUTCHER BIRD.

Adult.—Above, bluish-gray, white on scapulars, upper tail-coverts, forehead and over eyes; wings, black; secondaries and short primaries, tipped with white and white patch at base of the primaries; ear-coverts, black; lores, grayish-black, the latter not meeting across forehead next to bill; a white crescent on lower eyelid; tail, black, the outer web of the outside feathers and the tips of some of the others, white; below, white, with wavy blackish cross bars; bill and feet, black. *Immature*.—Similar, but more brownish or buffy.

Length.—9.25-10.75; wing, 4.35-4.60; tail, 4.50-4.75.

RANGE.—Northern North America. Breeds from Hudson Bay north to Arctic Coast. South in winter to Virginia, Kentucky, Kansas, Colorado, Arizona and northern California.

Nest, of sticks, twigs, weeds, bark, grass and feathers; in low tree or bush. *Eggs*, 4-6; dull white, thickly spotted with light-brown and lavender; 1.10 by .80.

In southern Indiana the Northern Shrike is usually an irregular, rare winter visitor, though occasionally it is found in some numbers. Northward it is a tolerably common winter resident. It arrives from November 1 to 15, and remains an indefinite time, its length perhaps determined by the food supply. It sometimes leaves in January or February and occasionally remains until the middle of March. The spring dates are very uncertain. The Loggerhead Shrike is an early migrant and is often mistaken for this species. While some rare and obscure birds are carefully noted, and concerning them we have good reports; of other birds that are quite conspicuous, we lack accurate information. It would be of value to have observations that shall distinguish between the Shrikes and give full information concerning the standing of each. The winter of 1880-81 this species was quite common at Brookville. The winter of 1885-6 it was numerous about Chicago, Ill.

Shrikes are commonly known as Butcher Birds. They live upon animal food; small birds, small mammals and insects being their main subsistence. Their life is one of continual warfare; a-preying upon others. While their bill is that of a rapacious bird, their feet are weak,



Northern Shrike. (Reduced.)

and they cannot hold their prey. For this reason they usually resort to thorn trees, where their victims are impaled upon thorns, sometimes making quite an array of small birds, beetles and other food, reminding one of a butcher's rack filled with meat. They are very bold when pursuing their prey. I once watched a Shrike chase a Junco in and out among the trees, and about the buildings of my back yard, coming very close to me several times, until finally its persistence was rewarded by catching the frightened bird, which it carried off to a neighboring tree. It paid no attention to me. They have been known to kill pet birds in cages when they were exposed in the open air and to dash themselves against a window in the attempt to seize a bird that was in plain view through the glass. When food becomes scarce in the country they have been known to go to the cities and live principally upon English Sparrows. They in turn are sometimes preyed upon. Mr. E. J. Chansler informed me of one at Bicknell, November 25, 1894, that barely escaped capture by a Sparrow Hawk.

The Northern Shrike has been reported breeding in Indiana. That is a mistake. Its breeding ground is far to the north. The other species must have been mistaken for it.

***246. (622). *Lanius ludovicianus* LINN.**

Loggerhead Shrike.

Synonym, BUTCHER BIRD.

Adult.—Similar to *L. borealis*, but smaller; lores and ear-coverts, deep black, the latter meeting across the forehead next the bill; upper tail-coverts and rump, sometimes white; below, white; sides, sometimes

grayish. *Immature*.—Tinged with brownish and buffy, marked with fine, wavy, dark crossbars; wings marked with buffy; black on sides of head, dusky.

Length, 8.50-9.50; wing, 3.75-4.10; tail, 3.65-4.25.

RANGE.—Eastern United States west to the Plains; from the Gulf of Mexico north on the Atlantic Coast to New Jersey and in the interior to the Great Lakes, Ontario and, east, along the south side of the St. Lawrence River to Maine. Winters from Missouri, southern Illinois and southern Indiana south.

Nest, low in tree or in bush, usually a thorn; of twigs, bark, grass and string. *Eggs*, 4-7; dull white, thickly spotted with light-brown and lavender; .97 by .73.

Summer resident, most numerous in central and northern Indiana, although in some localities elsewhere it is common. Resident some winters, at least, in the lower Wabash Valley. A specimen was taken at Mt. Carmel, Ill., January 5, 1886 (Ridgway, Orn. of Ill., I., p. 195).

In the northern portion of the State the specimens seem upon first notice to be the White-rumped Shrike (*Lanius ludovicianus excubitoroides* (Swains.)), but comparison of a series of birds shows that while many are light in color they fall between the two forms most nearly approaching the present species. The specimens from southern Indiana and into the middle of the State are darker and show at once to be this species. Few Shrikes breed south of the central part of the State. They frequent the more open, level land, making their headquarters along hedges, about thorn trees, in which they build nests and especially preferring a telegraph line near such places. There it may be seen, a conspicuous bird in black, blue-gray and white, sitting high up, or far out, on some prominent limb or on a pole or wire, waiting for its food to pass by. Insects, and the smaller birds, mammals and reptiles fall prey to it, and like the Northern Shrike it impales them upon thorns.

They usually appear as migrants in March. Early and late first appearances extending over a number of years are as follows: Tangier, March 7, 1896, March 21, 1895; Spearsville, March 13, 1894, March 28, 1895; Brookville, March 17, 1887, April 16, 1893; Greensburg, March 21, 1896, March 24, 1895; Irvington, March 14, 1889; Petersburg, Mich., March 11, 1893, April 25, 1897; Chicago, Ill., March 13, 1886, April 17, 1897.

As the woods are cleared away and hedges are planted, or thorn trees grow, these birds are appearing in new neighborhoods, and most everywhere in the more level portion of the State an increase in numbers is noted. They sometimes breed in April. Mr. E. J. Chansler found a nest containing six eggs at Bicknell, in April, 1897. Mr.

Roy Hathaway took a nest containing six well incubated eggs at Red Key, April 28, 1895. The nest was on the limb of an apple tree in an old orchard, twenty feet up. It was composed of sticks, straws, grasses, weed stems, rags, twine, pieces of cornstalks; lined with chicken feathers. It was also used by the pair in 1894. Messrs. L. A. and C. D. Test found nearly fully fledged young at Lafayette, May 15, 1890. They note some six or seven pairs breeding within three or four square miles adjoining that city that same spring. Prof. B. W. Evermann notes a set of six eggs taken at Pittsburg, May 10, 1884. Near Richmond, a set of eggs was taken June 22, 1888 (H. N. McCoy), and another, containing fresh eggs, June 6, 1890 (L. A. and C. D. Test).

Mr. L. T. Meyer, in remarking that they are prolific layers, says in the spring of 1886, in Lake County, the first laying of one of these birds was accidentally broken. It built another nest near by, and some boys broke the eggs. The third time it built in an orchard, and reared its young by the last of July. Early in August they begin to wander away from their breeding places, and frequently disappear from well known haunts in September. They have usually left the northern part of the State in October and most of the southern portion by November 1 to 15.

XLV. FAMILY VIREONIDÆ. VIREOS.

a¹. Wings not shorter than tail; outer toe longer than inner. **VIREO.** 151

151. GENUS VIREO VIRILLLOT.

a¹. Wing bars wanting; no conspicuous ring around eye. Subgenus **VIREOSYLVA** Bonaparte.

b¹. Primaries apparently 9, first obsolete.

c¹. Wing over 3.00; beneath white.

V. olivaceus (Linn.). 247

c². Wing under 3.00; below mostly sulphur yellow.

V. philadelphicus (Cass.). 248

b². Primaries evidently 10; first well developed, one-half inch or more long; wing less than 3.00; below whitish; sides buffy.

V. gilvus (Vieill.). 249

a². Wing bars conspicuous; ring around eye distinct.

d¹. Wing one-fourth or more longer than tail; first primary very small, or apparently wanting; not one-fourth length of second. Subgenus **LANIVIREO** Baird.

e¹. Throat, breast, and ring around eye yellow.

V. flavifrons (Vieill.). 250

e². Throat, breast, and ring around eye white.

V. solitarius (Wils.). 251

d². Wing short and rounded, not one-fourth longer than tail; first primary two-fifths or more the length of second. Subgenus **VIREO**.

f¹. White below; sides yellow; ring around eye yellow.

V. noveboracensis (Gmel.). 252

Subgenus *VIREOSTYLVA* Bonaparte.***247. (624). Vireo olivaceus (LINN.).****Red-eyed Vireo.**

Adult.—Above, olive-green; head, slate-gray; a distinct white stripe over the eye, bordered above by a dusky line; wings, not barred; below, white, sides of body lightly washed with olive; axillars and crissum, faintly tinged with yellow; iris, red.

Length, 5.50-6.50; wing, 3.10-3.30; tail, 3.15-3.30.

Note.—The larger size, dark stripe on each side of crown, and red eyes distinguish this species.

RANGE.—America, from Colombia and Trinidad over eastern North America to Labrador, the Mackenzie Valley and British Columbia. Accidental in Greenland. Breeds from Gulf States north. Winters from Florida south.

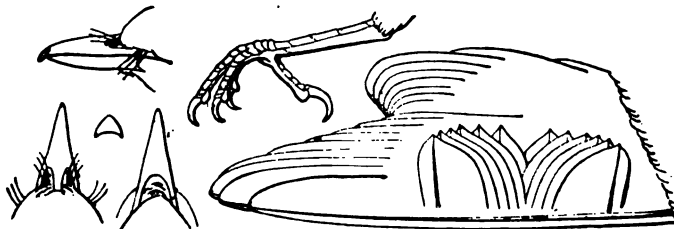
Nest, pensile, fastened by rim to a small horizontal fork, five to forty feet up; a light, thin structure of bark shreds, hornets' nest, grass and vegetable fibre, closely felted. *Eggs*, 3-5; white, with a few fine black and umber dots at the large end; .85 by .56.

The Red-eyed Vireo is one of the most common birds of the woodland. Especially is this true during the spring migrations, when many a one has, by reason of its inquisitiveness, fallen a victim to the collector's gun, and many another has revealed its identity by its inquiring tones, just in time to save its life. No bird in the woods is a greater nuisance to the collector than this Vireo. With the utmost care to avoid killing what he does not want, some are certain to get in the way of the load.

Any spring morning after mid-April that is bright and balmy, or lowering and warm, the visitor to the woods may expect to hear a bird's voice coming from the branches above. It seems to say, "See it? See it? Who are you? Cheer up." It is the Red-eyed Vireo. He would know his caller and give some of his life of cheer to him and to all who come within these quiet forest aisles. There the sounds of man's busy world are shut out and Nature rules, as in primeval days, over all who submit themselves to her sway. The Red-eyed Vireo's song is clear, musical and sweet. Its notes and actions are so inquisitive that one is disposed to regard it as an animated interrogation point.

The earliest record for the State is Greencastle, April 16, 1896. In 1894 it was not seen there until May 2. The following are other early and late dates when it was first seen: Brookville, April 17, 1896,

May 5, 1895; Bicknell, April 18, 1896, April 27, 1894; Bloomington, April 23, 1886, May 1, 1893; Lafayette, April 24, 1897, April 27, 1895; Sedan, April 21, 1896, May 5, 1889; Petersburg, Mich., April 28, 1888, May 10, 1893; Chicago, Ill., May 6, 1895, May 9, 1896 and 1897. Mr. J. G. Parker, Jr., notes it as sometimes appearing there by May 1. I have observed them mating by May 7 (1886), and late that month and in June the nest may be found, suspended from the fork of a horizontal limb of a beech, maple or other long-limbed tree, usually from five to twenty-five feet from the ground. It is a beau-



Details of structure of Red-eyed Vireo. Natural size.

tiful, cup-shaped structure, built of various kinds of fibres and felted together with all sorts of material, chief of which seems to be leaves and hornets' nests. To the outside is glued mosses, lichens and various other decorations. Sometimes two broods are said to be reared. They usually leave through September, but sing almost as long as they remain. I found them in full song September 10, 1897. The latest dates at which they have been noted in fall are Brookville, September 21, 1885; Bicknell, September 26, 1896; Lafayette, September 29, 1894; Sedan, October 1, 1889; Chicago, Ill., September 26, 1895; Warren County, September 25, 1897; Trafalgar, October 12, 1897. Mr. J. E. Beasley reports it from Lebanon, Ind., as late as October 23, 1894. It is one of a family of very beneficial birds. Prof. King examined 49 of these birds and found the principal food was 56 larvæ, principally caterpillars; 30 insect eggs; 67 chinch bugs; 32 beetles, and 6 grasshoppers. But 14 had eaten vegetable food, which was probably all wild (Geol. of Wis., I., pp. 521, 522).

248. (26). Vireo philadelphicus (CASS.).*Philadelphia Vireo.**

Synonyms, PHILADELPHIA VIREO, BROTHERLY LOVE VIREO

Adult.—Above, olive-green, the top of head gray or olive-gray; a white stripe over eye, but no dusky line above it. Below, greenish-yellow; iris, dark-brown. *Immature.*—Browner above. The extensive yellow below and the absence of the dusky line above the stripe over the eye serve to distinguish this species.



Details of structure of Philadelphia Vireo. Natural size.

Length, 4.75-5.40; wing, 2.50-2.75; tail, 1.90-2.20.

RANGE.—Eastern North America, from Panama to Assiniboia and Hudson Bay. Breeds from eastern Nebraska, central Indiana, New Hampshire and Maine, north. Winters in Central America.

Nest, pensile, suspended from forked limb, eight to ten feet from ground; of fine grass and birch bark. *Eggs*, 4; no apparent difference from those of *V. olivaceus* (Seaton, *The Auk*, Vol. II., 1885, p. 305).

The Philadelphia Vireo is generally a rare migrant, but in the northwestern part of the State, near Lake Michigan, it is sometimes rather common. It is also a rare summer resident. Mr. E. W. Nelson found two pairs of these birds in a dense willow thicket, bordering Mazon Creek, in Illinois, about sixty miles south of Chicago, the first of July, 1874 (*Bull. Essex Inst.*, Vol. VIII., 1876, p. 102). Mr. H. K. Coale took a single specimen in Starke County, Ind., June 8, 1884. Prof. B. W. Evermann says it is a rare summer resident in Carroll and Monroe counties. In Franklin County it is very rare. Mr. Rolla Rockafellar took two specimens at Brookville, April 30, 1887, and I took it there in May, 1882, May 9, 1887, and May 23, 1883. It was observed at Spearsville, May 4 and 5, 1897 (Barnett); Greencastle, May 7, three, and May 11, 1892 (Earlle); Lake County, May 16, 1877 and 1880 (Coale); Cook County, Ill., May 15, 1886 (Parker); May 19, 1877 (Coale); Petersburg, Mich., May 4, 1897 (Trombley). In the fall I found them at Brookville, September 21, 1885. They were noted at Cincinnati, O., September 18, 1877, September 17,

1878 (Dury and Freeman); Lake County, Ind., September 25, 1875 (Coale); Chicago, Ill., September 15, 1895 (Parker). This species has the size and general appearance at a little distance of the Warbling Vireo. No doubt it is often passed by because it is thought to be that bird. In the spring it is generally found, with us, in the denser woodland, where the Warbling Vireo never goes; but in the fall, in the trees, and among the bushes along streams, both species are sometimes seen.

Mr. William Brewster says its song is nearly identical with that of the Red-eyed Vireo. "The notes are generally pitched a little higher in the scale, while many of the utterances are feebler, and the whole strain is a trifle more disconnected." According to Dr. Jonathan Dwight, Jr., the speed at which the Red-eyed Vireo utters its song is approximately twice that of the Philadelphia. Their food is principally insects.

***249. (627). *Vireo gilvus* (VIEILL.).**

Warbling Vireo.

Synonym, WARBLING GREENLET.

Adult.—Above, olive-gray, brighter on the rump, sometimes grayer on the head, wings and tail, with more or less distinct olive edgings; whitish stripe over the eye. Below, white, breast sometimes tinged with greenish or buffy; sides slightly washed with olive; first primary very short, from a half inch to an inch long.

Length, 5.00-5.50; wing, 2.65-2.95; tail, 2.10-2.40.

Note.—The short first primary and the absence of the yellow lower parts serve to distinguish this species.

RANGE.—Eastern North America, from Mexico (Oaxaca) north to Manitoba and Hudson Bay. Breeds throughout its United States range. Winters south of the United States.

Nest and eggs similar to those of *V. olivaceus*, but usually placed higher. *Eggs*, .74 by .55.

The Warbling Vireo is the first of that family to arrive in southern Indiana, preceding the Red-eyed a few days. It is first observed among the elms, cottonwoods and sycamores along streams, which are choice places for it at all times. A little later it appears in orchards and lawns, and even frequents the well-shaded streets of towns. Its presence is announced by a beautiful song that comes from the top of some tall cottonwood, while the author often is invisible. Soon, however, an insect tempts him, and with a quick movement he collects it and

sings another song. Thus it is during its whole stay with us. It sings and works, morning, evening and mid-day, through the whole long summer. It is said it even sings when on its nest. It is a model of industry and cheerfulness. Its whole life while with us is spent doing good among the fruit and shade trees.

The earliest spring record is from Bicknell, where it was taken April 12, 1896, and the latest date of first arrival there is April 21, 1897. Other places their arrival has been observed as follows: Brookville, April 13, 1897, April 29, 1882; Richmond, April 22, 1897; Lafayette, April 28, 1896, May 6, 1895; Sedan, April 17,



Details of structure of Warbling Vireo. Natural size.

1896, May 4, 1889; Angola, April 27, 1896; Petersburg, Mich., April 21, 1889, April 30, 1897. Mr. J. G. Parker informs me they usually arrive at Chicago, Ill., May 1 to 10. I found them mating at Brookville, April 20, 1896, and nesting May 21, 1881. Messrs. L. A. and C. D. Test found a nest containing three eggs near Lafayette, July 7, 1892. It was built in a willow, fourteen feet up, and out over the water. They usually leave late in August and early in September. They sing as long as they stay. Very late migrants are reported, as follows: Plymouth, Mich., September 15, 1894; Sedan, Ind., September 18, 1892; Bicknell, September 12, 1894; Brookville, September 21, 1887.

Prof. King found that 16 Warbling Vireos had eaten 34 caterpillars, 5 beetles, 3 bugs, 5 flies, and 1 grasshopper (Geol. of Wis., I., p. 521). In an orchard infested with canker-worms Prof. Forbes found that 35 per cent. of their food was canker-worms (Rept. Mich. Hort. Soc., 1881, p. 204).

Subgenus *LANIVIREO* Baird.

***250. (628). *Vireo flavifrons* VIEILL.**

Yellow-throated Vireo.

Synonym, **YELLOW-THROATED GREENLET.**

Above, bright olive-green; rump, upper tail coverts and wing coverts, ashy; wings and tail, blackish, with two white bars crossing the former; line from nostrils to the eye and ring around the eye, yellow. Below, throat and breast, yellow; other under parts, white.

1878 (Dury and Freeman); Lake County, Ind., September 25, 1875 (Coale); Chicago, Ill., September 15, 1895 (Parker). This species has the size and general appearance at a little distance of the Warbling Vireo. No doubt it is often passed by because it is thought to be that bird. In the spring it is generally found, with us, in the denser woodland, where the Warbling Vireo never goes; but in the fall, in the trees, and among the bushes along streams, both species are sometimes seen.

Mr. William Brewster says its song is nearly identical with that of the Red-eyed Vireo. "The notes are generally pitched a little higher in the scale, while many of the utterances are feebler, and the whole strain is a trifle more disconnected." According to Dr. Jonathan Dwight, Jr., the speed at which the Red-eyed Vireo utters its song is approximately twice that of the Philadelphia. Their food is principally insects.

***249. (627). *Vireo gilvus* (VIEILL.).**

Warbling Vireo.

Synonym, WARBLING GREENLET.

Adult.—Above, olive-gray, brighter on the rump, sometimes grayer on the head, wings and tail, with more or less distinct olive edgings; whitish stripe over the eye. Below, white, breast sometimes tinged with greenish or buffy; sides slightly washed with olive; first primary very short, from a half inch to an inch long.

Length, 5.00-5.50; wing, 2.65-2.95; tail, 2.10-2.40.

Note.—The short first primary and the absence of the yellow lower parts serve to distinguish this species.

RANGE.—Eastern North America, from Mexico (Oaxaca) north to Manitoba and Hudson Bay. Breeds throughout its United States range. Winters south of the United States.

Nest and eggs similar to those of *V. olivaceus*, but usually placed higher. *Eggs*, .74 by .55.

The Warbling Vireo is the first of that family to arrive in southern Indiana, preceding the Red-eyed a few days. It is first observed among the elms, cottonwoods and sycamores along streams, which are choice places for it at all times. A little later it appears in orchards and lawns, and even frequents the well-shaded streets of towns. Its presence is announced by a beautiful song that comes from the top of some tall cottonwood, while the author often is invisible. Soon, however, an insect tempts him, and with a quick movement he collects it and

sings another song. Thus it is during its whole stay with us. It sings and works, morning, evening and mid-day, through the whole long summer. It is said it even sings when on its nest. It is a model of industry and cheerfulness. Its whole life while with us is spent doing good among the fruit and shade trees.

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Details of structure of Warbling Vireo. Natural size.

1896, May 4, 1889; Angola, April 27, 1896; Petersburg, Mich., April 21, 1889, April 30, 1897. Mr. J. G. Parker informs me they usually arrive at Chicago, Ill., May 1 to 10. I found them mating at Brookville, April 20, 1896, and nesting May 21, 1881. Messrs. L. A. and C. D. Test found a nest containing three eggs near Lafayette, July 7, 1892. It was built in a willow, fourteen feet up, and out over the water. They usually leave late in August and early in September. They sing as long as they stay. Very late migrants are reported, as follows: Plymouth, Mich., September 15, 1894; Sedan, Ind., September 18, 1892; Bicknell, September 12, 1894; Brookville, September 21, 1887.

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Subgenus *LANIVIREO* Baird.

***250. (628). *Vireo flavifrons* VIEILL.**

Yellow-throated Vireo.

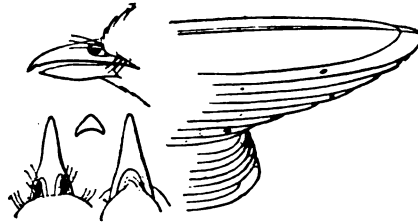
Synonym, **YELLOW-THROATED GREENLET.**

Above, bright olive-green; rump, upper tail coverts and wing coverts, ashy; wings and tail, blackish, with two white bars crossing the former; line from nostrils to the eye and ring around the eye, yellow. Below, throat and breast, yellow; other under parts, white.

Length, 5.00-5.85; wing, 3.00-3.20; tail, 2.00-2.30.

RANGE.—America, from Colombia and Cuba north over eastern United States to Newfoundland, Ontario and Manitoba. Breeds from Gulf of Mexico, north. Winters from Florida, south.

Nest, pensive; in fork of twig, three to thirty feet up; of fine bark, grass and spiders' webs, outside beautifully decorated with lichens. *Eggs*, 3-5; white, with spots of chestnut-brown, umber and black, chiefly at the larger end; .79 by .58.



Details of structure of Yellow-throated Vireo. Natural size.

Common migrant. Summer resident in some numbers northward, and more rarely southward. Breeds. Mr. Robert Ridgway reports it breeding in Knox and Gibson counties, where he says it frequents the luxuriant forests of the bottom lands. Mr. V. H. Barnett found a nest in an elm on the bank of a creek in Brown County, May 16, 1897. In the southeastern portion of the State it frequents wooded hillsides especially, where there is a considerable undergrowth. While it may breed there, I have no knowledge that it does. I found them paired at Brookville, May 4, 1886. Dr. F. W. Langdon notes that a few remain and breed about Cincinnati, O., and Mr. A. M. Hadley reports it breeding near Richmond, Ind. Messrs. L. A. and C. D. Test report it breeding at Lafayette, and from there northward it appears to nest more numerously.

Dates of earliest and latest first arrival are as follows: Bloomington, April 17, 1886, April 20, 1896; Brookville, April 19, 1881, May 7, 1885; Spearsville, April 19, 1894, April 24, 1895; Richmond, April 22, 1897; Greencastle, April 25, 1895; Lafayette, April 26, 1897, April 28, 1895; Chicago, Ill., April 21, 1895; Petersburg, Mich., April 27, 1888, May 5, 1889.

It has a "fine and peculiar song, commencing always with a clear and mellow *queery, queery*." It is quite different from that of either the Red-eyed or the Warbling Vireo. It has an alarm note that reminds me of that of a wren. I have only heard its song in the spring, though it is said to sing sometimes until early September.

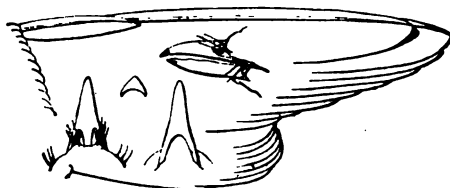
To me it seems the most sluggish of the Vireos. They begin their fall migration early in September, sometimes as early as the first of that month. Some years they are passing into October. The following are the latest dates I have: Plymouth, Mich., September 10, 1894; Chicago, Ill., September 21, 1896; Lafayette, Ind., September 2, 1896; Bicknell, September 18, 1894; Brookville, October 13, 1887.

Of 21 specimens examined, 7 had eaten caterpillars, among them geometers; 7, beetles, among them weevils and buprestis; 3, grasshoppers; 2, moths; 2, heteropterous insects, among them leaf-hoppers; 3, dipterous insects (King, Geol. of Wis., I., p. 523). While they are with us, practically their whole food is insects.

251. (629). Vireo solitarius (WILS.).

Blue-headed Vireo.

Synonyms, SOLITARY VIREO, SOLITARY GREENLET.



Details of structure of Blue-headed Vireo. Natural size.

Above, top and sides of head and nape, bluish-ash; back and upper tail coverts, olive-green; wings and tail, blackish, edged with olive-green, the former crossed with two whitish bars; line from nostril to eye and ring around eye, white. Below, white; sides, greenish-yellow.

Length, 5.00-6.00; wing, 2.90-3.00; tail, 2.10-2.20.

RANGE.—Eastern North America, from Guatemala and Cuba north to Hudson Bay and Mackenzie River (Ft. Simpson). Breeds from Massachusetts, Pennsylvania and Michigan, north. Winters from Florida, south.

Nest, pensile; in bush, five to eight feet up; of bark and fibres, outside often decorated with lichens. *Eggs*, 3-4; white, wreathed with chestnut or black spots about the larger end; .79 by .55.

The Blue-headed Vireo is a regular migrant; some years it is common, others rare. In the Whitewater Valley they frequent the wooded hillsides and upland woods, where they seem to prefer the undergrowth rather than the trees. In southern Indiana they are

found from April 23 to May 7, and in the northern part of the State from April 29 to May 14, and occasionally to May 26. In the fall they first appear northward September 1, and sometimes linger in the southern part of the State until October 10. The earliest and latest dates of first appearance in spring are as follows: Brookville, April 23, 1892, May 7, 1885; Richmond, April 26, 1897; Bloomington, April 28, 1895, May 9, 1892; Carroll County, May 10, 1884; Lafayette, May 14, 1892; Sedan, May 11, 1888; Petersburg, Mich., April 29, 1888, April 30, 1897; Chicago, Ill., May 1, 1896, May 23, 1896, May 26, 1894. They were last noted in fall at Sedan, September 22, 1889; in Lake County, September 18, 1888; Chicago, Ill., September 17, 1896; Brookville, Ind., October 5, 1886; Greencastle, October 10, 1890. I have no knowledge of its breeding in Indiana. During the migrations, I have found them quiet and shy. They are, however, more active than the Yellow-throated Vireo. I have never heard its song, though it is said to sing during the migrations. Dr. T. M. Brewer says its song is "a prolonged and very peculiar ditty, repeated at frequent intervals, and always identical. It begins with a pleasant warble, of a gradually ascending scale, which at a sudden pitch suddenly breaks down into a falsetto note. The song then rises again in a single high note and ceases."

"One specimen of three examined had eaten two caterpillars, one beetle and a hymenopterous insect" (King, Geol. of Wis., I., p. 523). The spring of 1897 I took some lice from a specimen of *V. solitarius* and sent them to Prof. Herbert Osborn, Ames, Iowa. He informs me that they are a species of *Docophorus*, belonging to the *communis* group. This is the first record he had of it from *a. Vireo*.

Subgenus *VIRRO* Vieillot.

***252. (631). *Vireo noveboracensis* (GMEL.).**

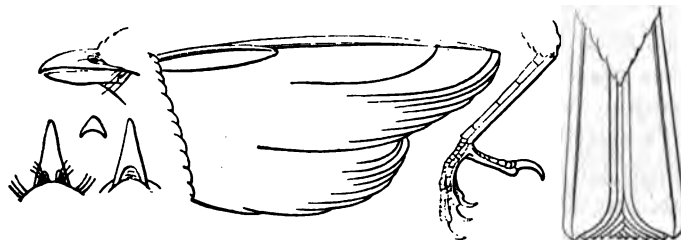
White-eyed Vireo.

Adult.—Above, bright olive-green, including crown; rump, brighter; a slight ashy gloss on the cervix; below, white, the sides of the breast and belly, the axillars and crissum, bright yellow; a bright yellow line from nostrils to and around eye; lores, dusky; two broad, yellowish wing bars; inner secondaries widely edged with the same; bill and feet, blackish plumbeous; eyes, white.

Length, 4.50-5.00; wing, 2.35-2.50; tail, 1.90-2.10.

RANGE.—Eastern North America, from Rocky Mountains, Honduras to Minnesota and New England. Breeds throughout its United States range and in the Bermudas. Winters from Florida southward.

Nest, in thickets, second-growth and swampy places along streams; oblong, bag-shaped, depending from a horizontal forked twig of tree or bush near ground (1 to 4 feet, rarely 8 feet); composed of moss, cocoons, bark, grass, lichens; lined with fine strips of bark. *Eggs*, 3-5; white, speckled with reddish-brown and dark purple; .72 by .54.



Details of structure of White-eyed Vireo. Natural size.

The White-eyed Vireo is a summer resident throughout most of Indiana. It is common in suitable localities in the southern part of the State, generally northward it is more rare, and in the north-western part, particularly about Lake Michigan, it seems to be wanting. It frequents thickets, brier patches, undergrowth in more open woods and the tangle about ravines in the rougher part of the State. It is seldom found far from water, and appears to be most often noticed about the edges of the denser growths, where it makes its home. While the greater number of persons do not know it, and it would be a strange bird to them, it is probable that those who are acquainted with it overestimate its numbers. They are often heard, but many birds whose voices we seldom hear are more numerous. They are irregular in their distribution, and every copse where they are found shelters one pair, and only one. When the bird discovers an intruder it comes to meet him. First flying to some opening where it can get a good look at him unperceived, it next makes itself known by a sharp "click," which is surprising in its suddenness. This is followed by a peculiar, jerky song, uttered with an alternating emphasis and repeated over and over again, as the fidgety little green bird is alternately seen and heard among the bushes close by the path. Mr. Ridgway says the boys in southern Illinois have interpreted its song as "chick'ty-beaver, lim'ber, stick," with special emphasis on the first syllable of each word. In Bermuda the natives say its notes are "ginger beer, quick!" Its song is heard in the morning and at mid-day; it sounds on bright and dark days alike, and continues, with sometimes a slight interruption in midsummer, from the day of its

arrival in the spring, through humid periods and droughts, to the time of its departure. September 14, 1897, it was heard singing as plainly as in June. In early springs they are usually distributed to our northern limits before the first of May, and more tardy seasons they are sometimes two weeks later. At Brookville their first appearance was noted April 21, 1896, May 11, 1882; at Bicknell, April 19, 1896, April 25, 1895; Spearsville, April 25, 1895, May 4, 1897; Greencastle, April 27, 1892, May 2, 1894; Lafayette, April 28, 1894, May 11, 1897; Waterloo, April 25, 1897. I found them paired May 2, 1884. Their nests vary in material according to location. Almost any available kind of material that can be worked in is used. Even fragments of newspapers are frequently worked in. For that reason Wilson called this bird the "Politician." They are built at the ends of horizontal forked twigs, from which they hang as purse-like structures to receive the most valuable possessions of their makers. Mr. Nehrling says: "The average length of the nest is 4.50 inches, the width at the rim 2.25 inches and somewhat wider toward the middle. The interior is about 2.00 inches deep, the opening 1.75 inches wide. At the time when the female begins to lay, the nest looks rugged and unfinished, and small branches of lichens hang down from it. The work is completed by the male, which labors assiduously to embellish and ornament the exterior."

They have been noted in the fall at Brookville, September 20, 1886; in Warren County, September 12, 1897; at Sedan, September 27, 1889.

Like the other members of its family, its food while with us is principally insects, notably in its season, the larvæ of the canker-worm. When in the south in winter it supplements its insect diet with palmetto berries and other wild fruit.

XLVI. FAMILY MNIOTILTIDÆ. WOOD WARBLERS.

- α^1 . Bill depressed, broader than deep at base; rictal bristles distinct; bill notched at tip; length 5.50 or less.
 - b^1 . Lower parts yellow; throat sometimes more or less black. SYLVANIA. 162
 - b^2 . Lower parts without yellow in our species. SETOPHAGA. 163
- α^2 . Bill not depressed, without distinct hook or notch at tip; rictal bristles, if present, scarcely reaching beyond the nostrils.
 - c^1 . Size small; length less than 6.50; bill slender, nearly cylindrical.
 - d^1 . Hind toe with claw as long as naked portion of tarsus in front; color black and white; no yellow. MNIOTILTA. 152
 - d^2 . Hind toe with claw much shorter than naked portion of tarsus in front.
 - e^1 . Middle toe with claw much shorter than naked portion of tarsus in front; or wings barred with white (*Dendroica dominica*); or outer tail feathers shortest (*Geothlypis trichas*).

- f*¹. Gape without apparent bristles; bills very acute.
 HELMINTHOPHILA. 156
- f*². Gape with distinct bristles.
- g*¹. Tail blotched with white, or inner webs of tail feathers bright yellow.
*A*¹. Back blue with gold spot; throat and legs yellow; bill acute, notch wanting. COMPSOTHELYPIS. 157
*A*². Coloration otherwise; bill not acute, plainly notched. DENDROICA. 158
- g*². Tail without white or yellow.
*i*¹. Length 5.50 or more; white beneath with dark streaks. SEIURUS. 159
*i*². Length less than 5.00; yellow beneath, not streaked. GEOTHLYPIS. 160
- c*¹. Middle toe with claw about equal to naked portion of tarsus in front.
*j*¹. Tail feathers partly white; head and lower parts bright yellow. PROTONOTARIA. 153
*j*². Tail feathers without white.
*k*¹. Bill much compressed; culmen straight, with a ridge at base; top of head pale brown. HELINAIA. 164
*k*². Bill not much compressed, culmen gently curved, base not ridged; top of head buff with two black stripes. HELMITHERUS. 155
- c*². Size large, more than 7.00; bill stout, much compressed, without notch or bristles; tail longer than wing. ICTERIA. 161

163. GENUS *MNIOTILTA* VIEILL.*253. (636). *Mniotilta varia* (LINN.).

Black and White Warbler.

Synonyms, BLACK AND WHITE CREEPER, BLACK AND WHITE CREEPING WARBLER.

Adult Male.—Entirely black and white in streaks, except on the belly, inner webs of tail feathers with more or less white; black on top of head, in front, below and behind eye; a white stripe through the middle of crown; one over the eye and one on each side of throat; throat, black; wing, with two white bars. *Female and Immature*.—Duller, and throat white.

Length, 4.55-5.50; wing, 2.60-2.90; tail, 1.95-2.25.

RANGE.—America, from Colombia and Venezuela over Eastern United States to Mackenzie Valley (Ft. Simpson). Breeds from Gulf States northward. Winters from Florida and Gulf Coast southward.

Nest, on ground against a bush or tree, or under a root, stone or bush; composed of leaves, grasses, strips of rotten wood; lined with hair, moss, rootlets or fine grass. *Eggs*, 5, rarely 4; white or creamy-white, speckled and spotted with chestnut, bay, hazel, cinnamon, rufous or lavender-gray, most abundant near large end, where often arranged in wreath; .69 by .54.

First to arrive among the warblers of the woodland is the Black and White Warbler. While the Myrtle Warbler may be found along the willow thickets some years before it comes, and the attractive song of the Sycamore Warbler sound from the tall, white trees above, they are not in the woods. There, particularly in the drier woodland, the well-known song of this symphony in black and white is borne to one's ears, but it requires sharp eyes to distinguish its form among the lights and shadows of the corrugated bark of the tree trunks. Persistence will be rewarded, and this warbler will reveal himself, a creeper with motion and habits that remind one much of a Nuthatch. The early arrivals are males. If they are very early the females may not come for ten days or more. Then both are very common most



Head of Black and White Warbler. Natural size.

years until early or late May, depending upon whether the observer is located north or south. A few always breed throughout the State. Then, in August, the migrants begin to return, and they are again common until late September and occasionally well into October. The first arrival at Brookville in 1882 was April 3d, in 1893, May 5. Other early and late spring dates of first arrival are: Bloomington, April 7, 1893; Richmond, April 17, 1897; Greensburg, April 18, 1896, April 27, 1895; Lafayette, April 18, 1896, May 6, 1894; Sedan, April 16, 1896, May 6, 1889; Chicago, April 17, 1886, May 9, 1894. I have observed them mating at Brookville, April 30, 1894. Its call is a sharp chip—a regular Warbler's call. The song is diligently poured forth at all hours of the day during migration. It sounds something like, "easy-easy-easy-easy-easy," the word repeated four to six times in a drawling monotone. It varies, however, in volume, being at times uttered very low and again sounding loud and distinct, carrying plainly a long distance.

The song season continues well into June. Mr. Bicknell says they sing again for a short season in mid-August. Nests with eggs may be found on the ground in retired woodland late in May and in June.

They are usually cleverly hid and quite difficult to find. Messrs. L. A. and C. D. Test took a nest with 6 eggs at Lafayette, April 30, 1897.

Migrants usually begin to return late in August. The following dates note the first appearance: Chicago, August 27, 1895; Lafayette, August 28, 1897; Greensburg, August 30, 1894. The latest fall dates are as follows: Plymouth, Mich., September 10, 1894; Chicago, Ill., September 26, 1893; Lafayette, September 12, 1896; Greensburg, September 3, 1894; Lake County, Ind., September 11, 1881; Warren County, September 16, 1897; Brookville, September 6, 1896.

A very late date is October 12, 1878, when Messrs. Dury and Freeman took it at Cincinnati. As an index to their food while here, I give the following: Of seventeen specimens examined, three ate 5 ants; 2, 21 caterpillars, 20 of which were small, measuring worms; 3, 4 moths; 3, 5 diptera; 6, 16 beetles; 2, 7 heteroptera; 1, a caddis fly, and 1, a small snail (Physa). Two had eaten 101 insect eggs, which were probably contained in insects eaten by the birds (King, Geol. of Wis., pp. 499, 500). Much of their food is very small insects, a great deal of those kinds that live upon forest trees and also trees of the orchard and lawn, which they sometimes visit.

153. *GRÆUS PROTONOTARIA* BAIRD.

*254. (637). **Protonotaria citrea** (BODD.).

Prothonotary Warbler.

Synonym, GOLDEN SWAMP WARBLER.

Adult Male.—Entire head, neck and lower parts, except crissum, rich orange yellow; crissum, white; back, olive-green; wings, rump and tail, bluish-gray; tail feathers, except middle pair, with white on inner web and tipped with dusky. *Adult Female*.—Similar, but colors not so bright; more white below.

Length, about 5.00-5.50; wing, 2.90-3.00; tail, 2.25.

RANGE.—East North America, from Panama and Cuba to Nebraska, Michigan and Pennsylvania. Casual in Maine, New Brunswick and Ontario. Breeds from Gulf of Mexico to Virginia, northern Indiana and Michigan. Winters south of United States.

Nest, in a natural cavity or excavation, in a tree or stump, often willow standing in or near water; composed of moss, roots, hair, leaves, plant fibre. *Eggs*, white, creamy or drab, generally glossy, more or less blotched and spotted with cinnamon, chestnut or gray (the latter often indistinct). Number, usually 6, often 5-7; rarely 3, 4 and 8. Eggs rounded ovate; .79 by .60; .62 by .54; average .70 by .57.

The Prothonotary Warbler is locally a summer resident and is in some places common. Its route of migration is up the Mississippi River to the Ohio, where a large number turn off to ascend the latter stream. Others keep on up the Mississippi, some leaving it at the Kaskaskia, the Missouri and the Illinois rivers, which they ascend a greater or less distance, while others continue along the main stream, ascending as far as Davenport, Ia. As they move along the Ohio they spread over the lowlands of southern Illinois. The Ohio Valley, above the mouth of the Wabash River, is unattractive to these swamp-loving birds, and they turn aside at the latter stream, ascending it to its source and crossing over into Ohio, where they have been found breeding at St. Mary's Reservoir, and to the vicinity of Cleveland, where it has been identified. It also occurs throughout the Kankakee River Valley in this State, and reaches the vicinity of Chicago, Ill., southwestern Michigan to Elkhart, Lagrange, Dekalb and Steuben counties, Ind.

The first account of its occurrence in Indiana was published by Mr. William Brewster in the Bulletin of the Nuttall Ornithological Club, 1878, p. 153, and details of a visit to the haunts of these birds in Wabash County, Ill., and Knox and Gibson counties, Ind. In 1884 Mr. H. K. Coale found it common at Davis Station, Starke County, and about the same time took a specimen on the shore of Lake Michigan in Lake County, Ind. These observations have been supplemented by many notes which show that about the swamps, cypress ponds and sluggish streams of the lower Wabash Valley, in some parts of the Kankakee Valley, notably at Water Valley, English Lake, Davis Station, Kouts and locally in Lagrange County, it is common and breeds abundantly. Mr. J. W. Byrkit has taken one specimen near Michigan City. Mrs. Jane L. Hine and Mr. J. P. Feagler have seen it in Dekalb County, and Hon. R. Wes. McBride took it in Elkhart County. Prof. B. W. Evermann has taken it in Carroll County (The Auk, Vol. VI., pp. 26, 27). Mr. Chauncey Juday reports it from Monroe County, where a specimen was taken at Harrodsburg, April 26, 1895.

Mr. J. E. Beasley took it at Lebanon, Boone County, May 23 and 29, 1894. In the remainder of the State, east and south of the valley of the Wabash River, it is practically unknown. The only two records are one given by Mr. Loucks in the publication referred to, upon the authority of Mr. J. H. Hitt, of Indianapolis, from Newcastle, where he mentions one nest having been found, and one specimen taken by Mr. E. L. Guthrie at Adams, Decatur County, and identified by Mr. John W. Shorten, of Cincinnati. In May, 1891, Mr. H. W.

McBride made a trip by boat from Pleasant Lake, Steuben County, following Pigeon Creek to its mouth, thence down the St. Joseph River to Elkhart, Ind. He passed through parts of Steuben, Lagrange and Elkhart counties, and St. Joseph County, Mich. May 9, 1891, he saw the first Prothonotary Warbler, a male, about five miles west of Angola. No others were seen in that county until the 13th of the month, when they were found breeding abundantly along the creek in Lagrange County, about six miles west of Lima. Except Redstarts and Cat Birds, they were the most common bird in that locality, actively engaged in nest building, over a stretch of territory two miles long. In a distance of about a half mile by the creek, he found eight nests without leaving his boat, none of which were quite completed. For about five miles then none were seen, although the character of the country and timber was the same. The nests were all in old Woodpeckers' holes in stubs over the water, and were composed of rootlets, grass and moss. He mentions one male taken which had a patch of orange-red surrounding the base of the bill. They were next found May 14, in Mattville Township, St. Joseph County, Mich., and for a distance of three and a half or four miles from White Pigeon were to be heard or seen all the time. Then no more were observed. They were located in colonies in low, damp, heavily-timbered country.

They arrive early in spring. Mr. Brewster noted them in Wabash County, Ill., and Knox County, April 19, 1878, and apparently all had arrived April 27. Mr. Ridgway noted the first in Knox County, Ind., April 18, 1881. Mr. A. H. Kendrick noted the first arrival at Ellsworth, Vigo County, April 10, 1896; Davis Station, May 11, 1884, more common May 18, 1884 (Coale). First arrival Elkhart County, April 16, 1891; Frankfort, April 20, 1896, common April 27, 1896; Waterloo, April 29, 1896 (Feagler); Steuben County, May 9, 1894.

When they first arrive they are silent and keep to the top of the small trees. Before they begin to be seen commonly about the water they commence singing. At a distance the song sounds much like the notes of the Solitary Sandpiper, but nearer at hand it resembles, "*peet, tsweet, tsweet, tsweet, tsweet, tsweet, tsweet,*" uttered in a ringing, penetrating tone at a rather high pitch. This sounds through the swamps morning, noon and night. Mating begins soon after arrival, and then comes searching for Woodpeckers' holes, natural cavities, and other suitable nesting places in stumps and dead trees. In such places the nest is built, and almost always in or over water. The females construct the nest and incubate the eggs. After they are completed a few days elapse before laying begins. An egg is laid daily

until the set is complete. It is said generally to rear two broods a season. The period of incubation is given at ten days to two weeks. The male supplies the female with food, but after the young are hatched it requires the combined efforts of both parents to keep them supplied with food, generally insects. Mr. Loucks mentions one nest that contained ten eggs, and thinks more than one bird must have laid them. In the southern part of the State they sometimes have full sets of eggs in April, but in its more northern homes it seldom has a complement before late in May. Mr. Robert Ridgway found a nest and four fresh eggs near Mt. Carmel, Ill., April 27, 1878. May 13, 1891, Mr. H. W. McBride found no completed nests in Lagrange County, Ind. May 28, 1896, Mr. J. G. Parker, Jr., found two nests containing young, and one with fresh eggs, along the Kankakee River, near Kouts. May 31, 1885, Mr. Coale found nests containing fresh eggs at Davis Station. At the same place, June 8, 1884, he found four nests with eggs partly incubated, and a week later, June 15, he found young out of the nests.

The localities they select for summer homes are of their own choosing, and we do not understand the rule they apply or the reason for their choice. Often in one locality they are common, while another, near by it, may be passed over and no Prothonotaries frequent it. They are not usually known. The uninviting places they seek are not commonly frequented by men other than naturalists, and the birds do not wander from the precincts of their retreats. They may, therefore, be very abundant in a swamp and be absolutely unknown to the inhabitants of the neighboring farms. When the young can fly and care for themselves, perhaps in July, they begin to become less noticeable. Fewer and fewer their numbers grow, until finally the last have passed away, retracing their steps of the preceding spring. The latest record I have is September 3, 1884, when a bird of the year was taken by Mr. Coale at Davis Station.

154. GENUS *HELINAIA* AUDUBON.

*255. (638). *Helinaia swainsonii* AUD.

Swainson's Warbler.

Adult.—Above, crown and nape, reddish-brown; rest of upper parts, including sides of neck, olive; rump, wings and tail, tinged with brownish; buffy or whitish stripe over the eye; below, creamy; sides, olive, or grayish. *Young, First Plumage*.—Wings and tail, like adult, but other upper parts, including crown and nape, also throat and breast, dull cinnamon-brown.

Length, 5.55; wing, 2.80; tail, 2.00; bill, .65 by .74.

RANGE.—Eastern North America, West Indies and Mexico, north to Virginia, Indiana, Illinois and Missouri. Probably breeds throughout its United States range. Winters south of United States.

Nest, in bush or canes, near ground or water (2 to 5 feet); of dry leaves, lined with pine needles and dry moss. Eggs, 3, rarely 5; white, very rarely, faintly marked; .74 by .56.

Much interest attaches to Swainson's, just as there does to Bachman's Warbler, on account of its history. Both birds were discovered by Rev. John Bachman, near Charleston, S. C., the former in 1832, the latter the year following. Swainson's Warbler remained almost unknown for forty years. Up to 1873 but three additional specimens appear to have been noted. That year Mr. N. C. Brown found it at Coosada, Elmore County, Ala. It was found later in Louisiana and Texas. In 1878 it was identified by Mr. Robert Ridgway in Knox County, Ind., where he says it breeds (Bulletin, Nutt. Orn. Club, 1878, p. 163; Orn. of Ill., I., pp. 121-123). It has since been determined to be a not uncommon summer resident in the vicinity of Charleston, S. C., where a number of its nests have been found. Mr. Arthur T. Wayne and Mr. Wm. Brewster have given accounts of its occurrence there (The Auk, Vol. II., 1885, pp. 65-80; Ibid, pp. 346-348). Mr. Brewster tells us it is a swamp-inhabiting bird, frequenting a peculiar kind of swamp. The favorite locality is called locally "pineland gall." He says: "Four things seem indispensable to its existence, viz.: water, tangled thickets, patches of cane and a rank growth of semi-aquatic plants." Its song consists of a series of clear, ringing whistles, the first four uttered rather slowly and in the same key, the remaining five or six given more rapidly, and in an evenly-descending scale." In general effect it recalls the song of the Water Thrush (*Seiurus noveboracensis*).

It is very loud, very rich, very beautiful, while it has an indescribably tender quality that thrills the senses after the sound has ceased. This Warbler is a sluggish bird, and is noted as being unsuspicious, or even inquisitive, retiring and, save when singing, very quiet. In all this it is directly the opposite of its near relative, the Worm-eating Warbler. It appears to nest indiscriminately in bushes in water, along the borders of streams or ponds and on high, dry land at some distance from water.

155. GENUS HELMITHERUS RAPINESQUE.

***256.** (639). **Helmitherus vermivorus** (GMEL.).**Worm-eating Warbler.**

Head of Worm-eating Warbler. Natural size.

Adult.—Head, black; a broad stripe through the middle of the crown, and one stripe over the eye, buff; a black stripe from eye backward; other upper parts, olive-green; wings, sometimes brownish; below, buff, lighter on the throat, belly and crissum. *Immature*.—More buffy below; head, with black more or less replaced with brown.

Length, 5.00-5.75; wing, 2.65-2.90; tail, 1.90-2.20; bill, .60-.65; tarsus, .70.

RANGE.—Eastern North America, from Yucatan and West Indies to Connecticut, Indiana and Nebraska; casually to Maine and Michigan. Breeds throughout its United States range. Winters south of United States.

Nest, in woods, dense grown with underbrush, at foot of tree or bush under overhanging bank, stone or root; made of dried leaves, lined with (hair moss, Pa. and N. C.) grass, horsehair. *Eggs*, 4, 5, 6, rarely 3; white or creamy-white, speckled and spotted, generally thickest at larger end, but not always, with chestnut, hazel, lavender-gray; .68 by .55.

The Worm-eating Warbler not many years ago was considered a rare bird in Indiana, but since its habits are better known it is found to be over the southern portion of the State, at least in suitable places, a common summer resident. Its home is among the denser woodlands, especially in rough country, on hillsides and in ravines, where "down timber" and underbrush is plentiful. In the Whitewater Valley in such localities it is one of the most abundant woodland species. No bird in its haunts exceeds it in numbers, unless it be the Oven Bird (*Seiurus aurocapillus*). In the lower Wabash Valley it is common. Prof. B. W. Evermann notes it as not common in Monroe County; rare in Vigo County, and does not give it in his list of Birds of Carroll County. He took a nest and three eggs at "Pine Hills," in Montgomery County, May 30, 1887. It is not common in Brown

County (Barnett). On the wooded hillsides and in the ravines along Sugar Creek in Parke and Montgomery counties I found it common in May, 19 and 20, 1887. At Lafayette it is not common, but breeds (L. A. and C. D. Test). In Dekalb County Mr. H. W. McBride found it tolerably common and breeding in May, 1890. It has also been noted rarely in that county in the vicinity of Waterloo by Mr. J. P. Feagler; at Sedan, by Mrs. Jane L. Hine. Mrs. Hine also observed it one summer (June 4) at Fish Lake, Steuben County. It has even crossed the line into Michigan, where it is noted as rare in Lenawee and Hillsdale counties (Cook, Birds of Michigan, p. 128).

In the northwestern portion of Indiana, beyond the Wabash River, I do not know of its occurrence, yet it has been taken on the shore of Lake Michigan at Waukegan, Ill., above Chicago, May 21, 1876 (Bulletin, Essex Inst., Vol. VIII., 1876, p. 98). Since 1879 I have noted its arrival at Brookville almost every spring. The earliest date it was first seen is April 17, 1896; the latest, May 3, 1882. It has been very hard to obtain data as to its movements. However, the following dates give the reported first appearance from the places and years named: Knox County, April 24, 1881; Bloomington, April 25, 1885, May 4, 1886; Spearsville, April 25, 1895, April 29, 1894; Lafayette, May 8, 1897, May 21, 1892; Waterloo, May 3, 1896. I have observed them mating by April 26, 1881, and as late as May 18, 1883, but am inclined to think some years they begin earlier than the first named date. They proceed at once to nest building. Mr. E. R. Quick found a nest five miles south of Brookville June 3, 1882. The locality is similar to that usually occupied, so I let the discoverer tell of it: "It (the nest) was situated on a densely wooded hillside, on the almost perpendicular bank of a gully, and was overhung by the base of a small shrub. It was composed of dried leaves and lined with fine shreds of bark of the grapevine. When driven from the nest, the bird refused to leave the vicinity, but with distended tail and fluttering wings moved round me at a distance of a few feet, until I called a companion, on whose appearance she flew away. The nest contained two addled eggs and one half-fledged young. The eggs were about the size of those of the summer Yellow Bird (*D. æstiva*), with diameter proportionately greater. They are pure white, dotted everywhere with light reddish-brown, most thickly at the larger end" (Journ. Cin. Soc. Nat. Hist., 1882, p. 94).

Prof. W. S. Blatchley took a nest and six fresh eggs, and one of the Cowbird, near Bloomington, May 12, 1886. The nest was at the base of a clump of ferns, and was composed of the leaves of "Maiden Hair" fern. The next day Prof. B. W. Evermann took a nest from a similar

location, containing five of the owner's eggs and two of the Cowbird. I have a young bird not able to fly that was taken near Greencastle. It very probably breeds wherever it is found in the State.

In 1886 I found young, July 1, at Brookville. The song very much resembles that of the Chipping Sparrow (*S. socialis*), and to the casual listener is not distinguishable from that bird. It is well to remember that whenever one hears the song of a "Chippy" in our denser woods it is not that bird, but a Worm-eating Warbler. Its song ceases about the middle of July. After it ceases singing and the young are able to care for themselves, they begin to leave. Their numbers keep on growing less and less until the last are usually gone late in August.

The Test brothers have found it at Lafayette as late as August 24, 1896, and I observed it at Brookville September 3, 1883. Its name has been given it from its habit of eating worms. It is a diligent searcher after grubs and other larvæ under the bark and among the decaying wood of limbs, fallen trees, rotting logs and other forest wreckage found lying upon the ground. The site of a "wind fall" is a favorite spot with them. And they are not averse to catching the insects along any old worm fence that passes through the woods. If one keeps quiet they are willing to come quite near to him, even upon the same log he is using for a seat. They move by hops, and I am always thinking of the motions of a Black and White Warbler as I see them, now going along a log and then going around it and under it, often when it would seem the hole was too small to permit the bird's body to pass through. They are very diligent and keep occupied all day long, but the time of greatest activity is in the morning and evening. When disturbed it often flies into a bush or even from twenty to forty feet up in a tree, and after a period of quiet waiting, during which it remains motionless, if nothing further disturbs it, the rattling, chipping song is uttered again and again. Presently it ceases and flies to its former hunting ground, uttering several vigorous, sharp "tchips," which very much resemble the call-note of the Oven Bird.

156. GENUS HELMINTHOPHILA RIDGWAY.

*a*¹. Wing varied with white and yellow.

*b*¹. Wing with large yellow patch; beneath not yellow.

H. pinus (Linn.). 257

*b*². Wing with two white bands; beneath bright yellow.

H. chrysoptera (Linn.). 258

*a*². Wing not varied.

*c*¹. Under tail coverts and more or less of under parts yellow.

*d*¹. Under parts bright yellow.

H. ruficapilla (Wils.). 259

d². Under parts greenish yellow, sometimes streaked and obscure.

H. celata (Say.). 260

c². Under tail coverts and more or less of under parts white.

H. peregrina (Wils.). 261

***257. (641). *Helminthophila pinus* (LINN.).**

Blue-winged Warbler.

Synonym, BLUE-WINGED YELLOW WARBLER.

Adult Male.—Head and entire lower parts to the crissum, bright yellow; crissum and under tail-coverts, white; a black stripe from bill through the eye; rest of body above, olive-green, brighter on the rump; wings and tail, blue-gray; the former with two white bars, the latter with three outer pairs of tail feathers marked with white on the inner web. *Adult Female*.—Only the front part of crown yellow; the streak through the eye dusky instead of black.

Length, 4.65-5.00; wing, 2.40-2.50; tail, 2.00-2.10.

RANGE.—Eastern North America, from Nicaragua north to Massachusetts, southern Michigan and southern Minnesota. Breeds throughout its United States range. Winters from Mexico south.

Nest, on ground in clearing or second growth, generally at foot of bush, among sprouts, or in bush one foot up; made of leaves, grape-vine bark, lined with fine grass or hair. *Eggs*, 4-5; white, finely and usually sparsely spotted with brown and black; .60 by .48.

This species seems to complement the one last mentioned. Their range is nearly identical. This frequenting the clearings, more open woodlands and pastures grown up with bushes, briars, weeds and sprouts; the other the dense forest. They arrive at the same time. Each is a great insect eater. Each has a peculiar song that, when once identified, can always be distinguished. The Blue-winged Warbler shows its bright colors in the bright sunlight of the open woods, while the Worm-eating Warbler's duller colors harmonize with the shades and shadows of the dark forest. In southern Indiana its favorite quarters are on the partially wooded hillsides, where there are many bushes. The stroller through such places late in April will often be saluted with a peculiar, rasping, stridulating effort, technically termed a song, that is not pretty, yet so strange as to demand his whole attention. The author is usually among the branches frequently in the top of a tree. Mr. F. M. Chapman well interprets this song. He says: "As a rule, it consists of the two drawled, wheezy notes, 'surê ê-chee,' the first inhaled, the second exhaled. A less common song uttered later in the season is, *wêê, chî-chî-chî-chî-chur*, and is sometimes accompanied by peculiar *kik* notes (B. E. N. A., p. 347). This is

uttered in August (*The Auk*, July, 1884, p. 211). The earliest one reached Brookville April 17, 1896, but one year the first one was not seen until April 30 (1884). Earliest and latest first arrivals for other points are: Brown County, April 23, 1895, April 29, 1894; Bloomington, April 27, 1886; Greencastle, April 27, 1895, May 7, 1892; Richmond, April 24, 1897; Carroll County, May 4, 1885, May 10, 1884; Wabash, May 1, 1894; Sedan, April 26, 1896, May 11, 1897; Petersburg, Mich., May 10, 1897. The last mentioned place is one of the few places in southern Michigan where it has been taken, and there it is rare. Mr. B. F. Gault has taken one specimen—the only one ever reported from Cook County, Illinois.

They are generally common in suitable places in southern Indiana, and locally, farther north, are found in some numbers. But usually in the northern half of the State it is rare or, at least, not common.

However, it is said to be increasing in numbers there, and is probably extending its range and usually breeds wherever found.

It begins mating some springs by April 18 (1896) and continues as late as May 8 (1887). Mr. W. O. Wallace says they frequent open thickets in Wabash County. The spring of 1892 he found a nest on a small bush about a foot from the ground. The nest was built by the female while the male sat on a bush near by and sang his odd little song. The nest was destroyed by cattle. Prof. B. W. Evermann found a nest with young just ready to fly in Carroll County in July, 1879 (*The Auk*, January, 1889, p. 27). After the young are reared they seem to leave their haunts, in southern Indiana, at least they apparently associate together in small numbers, perhaps a family remaining together, and seek open woods or thickets that are more moist than their breeding grounds. They depart for the south usually in August and September, but have been known to remain until late October. June 20, 1892, and a few days later, Messrs. L. A. and C. D. Test saw several each time near Lafayette. July 28 to August 6, 1894, Mr. J. O. Dunn, of Chicago, found them very common in the bushy woods about Bass Lake, Starke County. Mr. J. E. Beasley saw nine October 22, 1894, at Lebanon. This is the latest I have ever known it to be taken with us. In addition to the localities noted, it is reported from Allen County by Mr. C. A. Stockbridge.

This species, too, is an insect-eater. It not only lives upon the forms found close to the ground, but gleans among the bushes and even at times the smaller trees. I have often observed it about Buckeye trees of considerable size when they were in bloom, and I thought they were attracted by the insects about the flowers. This species is very fond of spiders, larvæ and beetles.

***258. (642). *Helminthophila chrysoptera* (LINN.).**

Golden-winged Warbler.

Synonyms, BLUE GOLDEN-WINGED WARBLER, GOLDEN-WINGED SWAMP WARBLER.

Adult Male.—Forehead and both rows of wing-coverts, and sometimes edges of secondaries, yellow; a black patch from bill backward, covering ear-coverts; throat, black; a white stripe over the eye and one on each side of throat; rest of upper parts, blue-gray, sometimes tinged with olive-green; below white, ashy on the sides; three outer pairs of tail feathers with the inner webs, partly white. *Adult Female*.—Black on throat and sides of head dull gray.

Length, 5.00; wing, 2.45-2.65; tail, 1.90-2.25.

RANGE.—America, from Colombia over eastern United States to Michigan, Minnesota, South Ontario and Vermont. Breeds from South Carolina along the mountains, New Jersey and Indiana north. Winters south of United States.

Nest, of dead leaves, stubs of bark, grass stems; lined with fine fibres; on or near ground, usually at base of bush or tuft of grass in dense, partly cleared growth of woods or bushy field. *Eggs*, 4-5, sometimes 6; white, or creamy-white; speckled chiefly, sometimes entirely, at the larger end, occasionally forming an indistinct wreath of burnt umber, russet, chestnut and lilac-gray; .63 by .49.

The Golden-winged Warbler is one of the most attractive of the genus. Its beauty, generally irregular appearance and peculiar song render it always a bird to be sought. Throughout the State it is a migrant, and in the northern part of the State where the conditions are favorable—where marshes and bogs in bushy or wooded land are found—it breeds, at places, in some numbers. It is not abundant at any place, and its numbers are, doubtless, decreasing. Wheaton tells us, with the exception of the Orange-crowned Warbler it is the rarest of the genus found in Ohio. In the Whitewater Valley Mr. Quick and I have found it to be very irregular. Some years none were found, others it was very common. Usually, however, a few were found. The spring of 1881 it was quite numerous. There they frequent the sugar, oak and hickory woods on and near the hill tops. We never found them in the river valleys. It has never been observed there, in fall. In the lower Wabash region it would seem to be a common migrant.

Mr. Robert Ridgway says it is "a common species during the spring migration in Wabash County, Illinois, and in adjacent counties of Indiana, and is hardly, if at all, less rare in fall." He has also found

it breeding in Richland County, Illinois (Orn. of Ill., I., pp. 127, 128). In the northern part of the State it is also a common migrant. At Davis Station, Starke County, Mr. H. K. Coale found them very common and breeding, the spring of 1884. The males were first seen, and were common May 11. That day he shot four and saw others. May 18 they were also numerous. Then he shot a female—the first seen.

Mrs. Jane L. Hine has found them commonly in Dekalb County. There, she says, it is a regular summer resident. Almost every large swamp has its pair. Their notes may be heard almost constantly in the spring. She reports them as breeding, but notes they are becoming less commonly seen. In Monroe County, Michigan, it formerly bred quite commonly. Mr. H. W. McBride found a pair building their nest in Springfield Township, Lagrange County, about May 12, 1891.

Early and late dates of first arrival in Indiana are: Brookville, April 29, 1879, May 11, 1885; Richmond, April 22, 1897; Greensburg, May 7, 1893; Bloomington, May 4, 1886; Camden, May 6, 1885; Lafayette, April 24, 1897; Terre Haute, May 17, 1890; Sedan, April 27, 1896, May 8, 1894; Petersburg, Mich., May 2, 1892, May 10, 1893; Plymouth, Mich., April 30, 1896, May 18, 1893; Ann Arbor, Mich., May 12, 1889; Chicago, Ill., May 9, 1885. In the fall they are very irregular in their movements, also. Some years they disappear the latter part of August, others in September, and again the late movers remain in the vicinity of their breeding grounds into October. The following are some dates of last fall records: Plymouth, Mich., August 20, 1894; Lafayette, Ind., present August 30, September 12, 1895; Warren County, September 14, 1897 (Bartlett); Chicago, Ill., August 30, 1895. Prof. E. L. Moseley informs me that several were seen at Grand Rapids, Mich., October 4, 1886.

“Their peculiar, drawling, lisping song is sure, even if I have not heard it for several years, to strike my ear upon entering the woods where one is singing. It consists of four syllables, zee-zee-zee-zee, slowly brought forth, with a peculiar, vibratory effort. When singing, they are usually most lively and wildest, sometimes leading the collector a long chase, as they quickly cover considerable distances in the woods. At other times, when not singing, they are occasionally rather tame. However, as I have usually found them quite well up in the trees, they cannot be said to compare in ease of approach with the last species. In addition to the records of its breeding in Richland County, Ill., given by Mr. Robert Ridgway (Orn. of Ill., I., p. 127), Mr. A. C. Poling has found it nesting in the Mississippi bottoms in that State. There it frequents the lowlands, covered with grass, with an occasional bush or grove of trees, and all the nests found were

placed above the ground. In Ohio, Dr. Wheaton records its breeding in the vicinity of Columbus. In that State it prefers swampy places and nests on the ground, frequently under the broad leaf of the skunk cabbage" (B. of O., p. 243).

259. (645). *Helminthophila ruficapilla* (WILS.).

Nashville Warbler.

Adult Male.—Above, plain olive-green; head and sides of neck, grayish; a white ring around the eye; crown, with a concealed chestnut patch; under parts, bright yellow, whitening on the middle of the belly; wings and tail without white. *Adult Female and Immature*.—Similar, but colors duller; chestnut on crown, less distinct or wanting.

Length, 4.20-5.00; wing, 2.30-2.45; tail, 1.85-1.90.

RANGE.—Eastern North America, from Guatemala north to Labrador and Hudson Bay region (Cumberland House), west to Rocky Mountains. Breeds from northern Illinois and Connecticut north. Winters in Mexico and Central America.

Nest, in open woods that generally are wet; on ground, in tuft of grass, depression at base of tree or bush; of grass and moss, sometimes pine needles, lined with hair or fine roots. *Eggs*, 4, sometimes 3 and 5; white or creamy-white, speckled with gray, cinnamon, hazel, vinaceous or lilac (reddish-brown, Davie); .59 by .48.

The Nashville Warbler is usually rather a rare migrant. At times, however, it is common in one locality or another. Dr. Brayton says, upon the authority of Mr. Nelson, it is a "very common migrant in Lake County and also a rare resident" (Birds of Ind., p. 103). It was rather common in Franklin County May 5-11, 1882; also in 1885. Prof. Evermann found it common in Carroll County, May 4-7, 1885. Mr. Alden M. Hadley reports it abundant in Wayne County, April 24 to May 10, 1897. In Monroe County it was rather common, April 27 to May 1, 1886 (Evermann, Blatchley). Mr. O. W. Wallace says it has been very abundant at times at Wabash, arriving as early as April 28. Mr. C. E. Aiken informs me it was not rare in Lake County in 1871, and Mrs. Hine says it was very common in Dekalb County the spring of 1889. About Chicago they are reported as rare migrants. I have but one record from there in recent years. They arrive some springs in southern Indiana by April 15, and in the extreme northern part of the State by April 29. I do not know that in late years it has been observed within the State after May 11 (1885), though it sometimes lingers in southern Michigan until May 25. The earliest first

arrival at Brookville (and in the State) is April 15, 1887; the latest, May 5, 1882. The earliest it has been noted in the spring at Richmond is April 24, 1897, when it remained to May 10; the latest first arrival was April 28, 1888. The following other dates give, respectively, the earliest and latest date of first arrival: Bloomington, April 27, 1886; Moore's Hill, May 10, 1893; Spearsville, May 5, 1897; Petersburg, Mich., May 9, 1889, May 18, 1893, while both in 1892 and 1893 it was noted until May 25; Terre Haute, May 3, 1890; Sedan, April 29, 1896-7, May 8, 1892. I have usually found them in more open sugar woods, where they generally kept high in the trees. Mr. Wallace, while he generally finds them in the tree tops, has taken it in an orchard, and once in an open blackberry patch. Mr. J. A. Allen says: "Its song so much resembles that of the Chestnut Warbler that it might readily be mistaken." Minot says it sounds like, "*wee-see-wee-see, wit-a-wit-a-wit.*" The first part of this reminds one of the song of the Black and White Warbler. To me, the song has a peculiar, vibratory, wheezy sound that recalls some of the peculiar sounds of other members of the family. It has not been reported as nesting in Indiana, but it is given by Mr. Nelson as breeding in northeastern Illinois, and Mr. Philo W. Smith, Jr., records its breeding in Fulton County, Ill. (Bay State Oologist, Vol. I., May, 1888, p. 44).

Like the other members of this genus, it is a great insect eater, busily searching among the foliage of the trees it frequents. Two specimens contained 4 small caterpillars and a few fragments of insects (Prof. King, Geol. of Wis., p. 500).

260. (646). *Helminthophila celata* (SAY.).

Orange-crowned Warbler.

Adult Male.—Above, olive-green, dulled with ashy, brighter on the rump; a concealed patch of orange-rufous on the crown; yellowish ring around eye; wing, without white markings; inner webs of tail feathers, with white edgings; below, whitish washed with yellowish and ashy. *Adult Female*.—Orange and rufous crown, less distinct or wanting; tail feathers, with no white. *Immature*.—Lacking the orange-rufous crown patch; wings, with two whitish bars; ring around eye, white.

Length, 4.60-5.30; wing, 2.31-2.52; tail, 1.92-2.10.

RANGE.—North America, from Mexico northward over eastern United States, Rocky Mountains to mouth of Yukon and Mackenzie River; rare north of Virginia, east of Alleghany Mountains. Breeds from Utah north through Rocky Mountains. Winters south of United States.

Nest, on ground, under low bush; of grass and leaves. *Eggs*, 4-5; white, marked with spots and blotches of reddish-brown and purplish-slate; .63 by .49.

This is the rarest bird of its genus in Indiana, and is only known as a migrant. Usually it is very rare; often it is entirely wanting for years together, and very rarely it is seen in some numbers. I have found it in Franklin County but four times in nineteen years—April 29, and one day in May, 1880, May 9, 1885, and May 5, 1889. On the next to the last date it was tolerably common in a sugar wood, on a hillside near Brookville, in company with Nashville Warblers. In 1871, Mr. C. E. Aiken informs me, it was not rare in Lake County. In that county, also, Mr. H. K. Coale obtained a specimen, May 16, 1877, and two days later one in Cook County, Ill., not far away. The next record I have from Cook County is of a specimen taken by Mr. C. A. Tallman, May 16, 1897. In a bush on the edge of a woods at Wabash, May 15, 1892, one was taken by Mr. W. O. Wallace, and one was obtained by Mr. A. M. Hadley at Richmond, May 1, 1897. Several specimens have been taken in Marion County (Brayton). It has also been reported from Knox and Gibson counties (Ridgway), Vigo County (Evermann), Carroll County (Sterling), Dekalb County (H. W. McBride). They return in the fall in September. Dr. Wheaton heard it sing and describes its effort as a "loud, emphatic and rather monotonous song, resembling as nearly as I can describe the syllables, 'chicky-tick-tick-tick-tick;' this song was louder and more decidedly emphasized than that of any member of the genus with which I am acquainted" (Birds of Ohio, p. 244). Mr. Ernest E. Thompson says "it has a loud song-like chip-e-chip-e, chip-e, chip-e, chip-e" (Proc. U. S. N. M., Vol. XIII., p. 616).

261. (647). *Helminthophila peregrina* (WILS.).

Tennessee Warbler.

Adult Male.—Above, olive-green; head and neck, ash-gray, with no colored crown patch, but with a dusky stripe through the eye and an indistinct white stripe over and a white ring around the eye; wings and tail, with no white; below, white. *Adult Female*.—Similar, but with the crown tinged with greenish, and lower parts, especially on the sides, with yellowish-olive. *Immature*.—Head and all upper parts, olive-green; lower parts, washed with olive-yellow; lower tail coverts, white.

Remarks.—The adults of this and the two preceding species may be distinguished with ease; immature birds, however, are frequently con-

fused. The Nashville is distinctly yellow on the breast and under tail-coverts; the Orange-crowned is pale greenish-yellow, with dusky streaks, and yellow under tail-coverts; the Tennessee is pale greenish-yellow, without streaks, and with the under tail coverts white. (Chapman, B. E. N. A.).

Length, 4.50-5.00; wing, 2.40-2.75; tail, 1.60-1.85.

RANGE.—America, from Colombia north over United States, east of Rocky Mountains to Hudson Bay, Mackenzie Valley (Ft. Simpson). Breeds from Minnesota, northern New York and Massachusetts, north. Winters from Cuba and Central America, south.

Nest, on ground, of grass, moss and bark strips, lined with fine grass and hair. *Eggs*, 4; white, marked with reddish-brown about the larger end; .60 by .50.

The Tennessee Warbler is a migrant, regular and usually abundant in fall; much less numerous and frequently rare in the spring. In fall, they may be found almost everywhere, but are most common about bushy ravines, brier patches, overgrown fencerows, and weed-patches. In spring it is found in woodlands. At Bloomington, both Profs. Blatchley and Evermann thought it less numerous than the Nashville Warbler. The last named gentleman made a similar report on its occurrence in Carroll County. These estimates, I presume, refer to its occurrence in the spring. In Franklin County I have found it fully as numerous as the Nashville, in spring, though, like that species, some years it is rare and others apparently wanting.

This species is late in arriving and seldom appears before the 1st of May. The following records give the earliest and latest record of its first appearance in spring, and indicates its comparative abundance: Brookville, April 20, 1884, not common, May 17, 1882, rare; Bloomington, April 27, 1886, rare, May 3 to 10, 1890, common; Chicago, Ill., May 4, 1895, rather common, May 21, 1896, common; Petersburg, Mich., May 15, 1888, rare. In Illinois, Mr. Ridgway gives it as an abundant migrant, both spring and fall. Like the last mentioned species, it breeds far north. The present species is a bird of eastern North America, extending west only to the Rocky Mountains. Mr. Ridgway says: "It seems to be far more numerous west of the Alleghanies than eastward of that range, in which respect it is like the Philadelphia Vireo and several other migratory birds, which can scarcely be considered as more than stragglers in the Atlantic States" (B. of Ill., I., p. 130). Mr. Thompson says: "Its song begins with a note like *chipiti, chipiti*, repeated a dozen or more times with increasing rapidity, then suddenly changed into a mere twitter" (Proc. U. S. N. M., Vol. XIII., p. 616). In the fall the Tennessee Warblers

begin to reach the northern part of the State the very last of August, and sometimes have nearly reached the Ohio River by the end of the first week in September. Then they pass leisurely for five or six weeks, being found almost up to the middle of October. The following give the dates of earliest appearance and last record, respectively, for the fall: Chicago, Ill., August 31, 1895, October 9, 1896; Lake County, Ind., September 3, 1884; September 28, 1879; Greencastle, Ind., September 15, 1890; Greensburg, present September 22 to October 11, 1896; Bicknell, September 8, 1896, September 19, 1894; Brookville, September 6, 1886, October 13, 1882. At this time of the year they may be seen associating with Sparrows and Redpoll Warblers in the more open ground, and, when in the woods, with Wilson's and Nashville Warblers. Some autumns they are very abundant. While they, on the whole, are quite destructive to insects, yet in the fall there are two habits that are against this little green Warbler. It sometimes eats the fruit of the Poison Vine (*Rhus toxicodendron*), and becomes a distributor of its seeds; the other is a habit it has formed of puncturing grapes. This has been reported to me on several occasions, but I have never seen it myself. Prof. King also refers to it. He examined 33 stomachs. Two had eaten 2 very small hymenoptera (probably parasites); 7, 13 caterpillars; 3, 15 diptera; 6, 13 beetles; 3, 42 plant lice; 3, 35 small heteroptera, and 1, 11 insect eggs (Geol. of Wis., I., pp. 501, 502).

157. GENUS COMPSOTHLYPIS CARANIS.

α^1 . Size smaller, bill longer.

C. americana (Linn.). 262

α^2 . Size larger; bill shorter.

C. americana usneæ Brewst. 263

*262. (648). *Compsothlypis americana* (LINN.).

Parula Warbler.

Synonym, BLUE YELLOW-BACKED WARBLER.

Male in Spring.—Above, blue, back with golden-brown patch; throat and breast, yellow, with a rich brown or blackish patch, the former sometimes extending along the sides; belly, eyelids, two wing bars and several tail spots, white; lores, black; upper mandible, black; lower, flesh-colored. *Female in Spring*.—With the blue less bright; back and throat patches not so well defined. *Immature*.—With these patches obscure or wanting, but always recognizable by the other marks and very small size. "Averaging slightly smaller, but with a

longer bill. *Adult Male*.—With more yellow on the under parts and less black or blackish on the lores and malar region; the dark collar across the jugulum, narrow, obscure, often nearly wanting; the chest, pale, diffuse russet, without obvious markings" (Brewster).

Length, 4.12-4.95; wing, 2.20-2.40; tail, 1.60-1.85.

RANGE.—Eastern North America, from Guatemala and West Indies to District of Columbia, southern Illinois and southern Indiana. Breeds from south Atlantic and Gulf States, east of Texas, north. Winters from Florida, southward.

Nest, of long moss (*Tillandsia*) woven together, lined with feathers and soft materials. *Eggs*, 5; white, speckled and spotted, almost wholly at larger ends, with lilac and bright reddish-brown; .69 by .47.

Hitherto all the Parula Warblers of eastern North America have been classed as this form. In the Auk for January, 1896, Mr. William Brewster has separated them, giving to the birds breeding in the northern United States and Canada the sub-specific name *usneæ*, and assuring us that the type of Linnæus' species was a southern bird, and therefore the birds from that region should retain the above name. He says, in his collection are apparently typical examples of this form, from Mt. Carmel, Ill. Mr. Robert Ridgway writes me: "The breeding bird of the lower Wabash Valley, and probably other extreme southern or southwestern parts of the State (Indiana), is true *C. americana*." There is no record of its having been taken farther north or even elsewhere in the State. In 1881, Mr. Ridgway says they arrived in Knox County, April 18 (Bull. N. O. Club, Vol. VII., No. 1, 1882).

He has also informed us that it nests in Knox and Gibson counties. From there it breeds southward throughout its range, usually building in the draperies of the beautiful "Spanish moss" (*Tillandsia*).

Possibly the strange nest found by Mr. Otto Widmann, near St. Louis, may have belonged to this bird. In 1885 he found the nest of a Parula Warbler in a bunch of light drift material—straw, grass, dry leaves, etc.—left by a freshet, attached to the end of the branch of a birch tree overhanging the water.

In structure this nest is similar to other nests of this bird, with the exception that the straw and leaves take the place of the lichens and mosses. Mr. H. Nehrling says the song of the Parula consists of "wiry, rather shrill, notes, sounding like *chin-rin-in-ruh*."

263. (—) *Compsothlypis americana usneæ*. BREWSTER.**Northern Parula Warbler.**

Averaging slightly larger, but with a shorter bill.*

Adult Male.—With less yellow on the under parts and more black or blackish on the lores and malar region; the dark collar across the jugulum, black or blackish, broad and conspicuous; the chest, mottled or spotted with rich brownish-chestnut.

BREEDING RANGE.—New England, New York and westward along the northern tier of States; northward into the Maritime Provinces and Canada (Brewster), Colorado (?). Winter range, possibly same as last.

Nest, on both live and dead trees, from near ground to fifty feet high; in bushes in swamps; of bunches of *Usnea* moss, lined with same, a little wool or grass. *Eggs*, 4, occasionally 3 and 5, rarely 6 or 7; white, or creamy-white, more or less distinctly speckled and spotted with reddish-brown and lilac; markings generally thickest near large end, around which they often form a wreath; .64 by .47.

This bird has been separated from the typical southern form by Mr. William Brewster (see *The Auk*, January, 1896, pp. 44-46). It includes those birds which breed to the northward of the Ohio Valley—excepting the lower part—and perhaps north of the District of Columbia.

We do not know the exact limits of the breeding range, nor can the winter range of each of the two races be determined. As the southern bird nests among the festoons of "Spanish moss" (*Tillandsia*), the present birds prefer to nest in bunches of "Old Man" moss (*Usnea*). Wherever there is damp woods, where this moss grows commonly, these birds may be looked for through the summer. Mr. Robert Ridgway writes me of this form in Indiana, that birds breeding in the extreme northern part of the State are probably *C. a. usneæ*. He says both *P. americana* (breeding birds) and *C. a. usneæ* (migrants) are in the United States National Museum, from Vincennes and Wheatland. A small collection of Parula Warblers was sent to Mr. Brewster for examination. He writes: "Most of your skins appear to be intermediate between *americana* and *usneæ*. Several of them have bills nearly as in the former, but the coloring is about half-way between the two. Two or three are apparently *usneæ*, and were, no doubt, migrants." He tells me those breeding in Michigan in the

*NOTE.—Except the breeding time, nothing is yet determined as to the range of either form. Likewise, in the absence of measurements, I can not give them. Therefore, the range, except in breeding season, and measurements, given above, cover both forms.

region in which he has collected are *C. a. usneæ*. It seems, then, that in the State are to be found the typical southern form, as summer residents, in the lower Wabash Valley; the typical northern form, as migrants, at least, and birds intermediate between them—these latter possibly breeding. A few birds remain through the summer, and Mrs. J. L. Hine says it breeds in Dekalb County, but, so far as I know, none have been found breeding. In Laporte County it is a summer resident (Byrkit). It was taken June 3, 1888, by Mr. Ruthven Deane, at English Lake; in Putnam County, July 2, 1889, by Mr. J. F. Clearwaters. Mr. Charles Dury found them near Cincinnati, July 18 and 31, and August 27, 1879. Dr. Wheaton speaks of them breeding in northern Ohio, possibly south of Columbus (B. of Ohio, p. 239), and Prof. Cook says it occasionally breeds in Michigan (B. of Mich.). Mr. Nelson notes that it breeds rarely in northeastern Illinois. I have, for the present, referred all records north of Knox County to this form. They appear within the State, most seasons, in the latter half of April, and migrants seldom linger after the middle of May. I have found the first arrivals at Brookville as early as April 25 (1881), and as late as May 16 (1884). They have been observed at Bloomington as early as April 21 (1885), and April 27 (1886); at Terre Haute, April 24, 1890, May 3, 1887; Lafayette, April 28, 1893; Carroll County, May 4 to May 10, 1885; Wabash County, May 2 to 10, 1892; Sedan, April 29, 1897, May 4, 1894; Lake County, May 24 and 26, 1894; Chicago, Ill., May 9, 1886, May 15, 1895.

Even when they arrive early they are usually mating. I have seen them so engaged as early as April 25. They are as variable in numbers as they are in the time of arrival. Some years they are common, and others, quite rare or wanting. Usually when they are common they arrive early, and again a few or even a single representative will be seen late in the migrations. I have always found them in the heavier woodlands, where they frequent the higher tree-tops, preferably maple, elm and oak. Their habits remind one of those of a Titmouse, but they are more active. Occasionally they utter a peculiar song, ending in a peculiar little screech. It is the same as that given under the last species. Its food consists of small insects, including flies and various other winged forms, spiders and caterpillars, which they are very industrious in gathering from the unfolding leaves and inconspicuous flowers of the trees they frequent. In fall, the return journey is made in August and September. The latest dates when it was seen are: Chicago, Ill., September 15, 1885, September 23, 1895; Cincinnati, O., August 27, 1879, September 28, 1878; Lake County, September 18, 1881.

158. GENUS DENDROICA GRAY.

- a*¹. Bill slender, very acute; gonys slightly concave near tip; notch wanting or very indistinct. Subgenus *PERISSOGLOSSA* Baird. *D. tigrina* (Gmel.). 264
- a*². Bill conical; gonys convex; notch distinct.
- b*¹. Tail feathers edged with yellow; plumage chiefly yellow.
D. aestiva (Gmel.). 265
- b*². Tail feathers blotched with white.
- c*¹. Primaries with white blotch near bases; no wing bars.
D. caerulescens (Gmel.). 266
- c*². Primaries without white blotch.
- d*¹. Wing bars, if present, not white.
- e*¹. White below; crown and wing patch more or less yellow.
D. pennsylvanica (Linn.). 270
- e*². Yellow below.
- f*¹. Sides reddish streaked; crown chestnut.
D. palmarum (Gmel.). 278
- f*². Sides black streaked.
- g*¹. Back olive with reddish spots. *D. discolor* (Vieill.). 279
- g*². Back ashy. *D. kirtlandi* Baird. 276
- d*². Wing bars or wing patch white.
- h*¹. Rump yellow.
- i*¹. Crown clear ash; yellow and streaked below.
D. maculosa (Gmel.). 268
- i*². Crown with yellow spot; white and streaked below.
D. coronata (Linn.). 267
- h*². Rump not yellow.
- j*¹. No distinct yellow anywhere.
- k*¹. Crown, blue or greenish, like the back.
D. rara (Wils.). 269
- k*². Crown not blue or greenish.
- l*¹. Crown black, much streaked.
D. striata (Forst.). 272
- l*². Crown and throat chestnut; buffy below.
D. castanea (Wils.). 271
- j*². More or less yellow or orange.
- m*¹. Crown with orange or yellow spot; throat orange or yellow.
D. blackburniae (Gmel.). 278
- m*². Crown bluish or yellowish; not as above.
- n*¹. Throat black (sometimes obscured by yellow tips to feathers); outer tail feather white edged.
D. virens (Gmel.). 275
- n*². Throat yellow.
- o*¹. Back blue gray; cheeks black.
D. dominica albilora Ridgw. 274
- o*². Back yellowish olive; cheeks the same color.
D. vigorsii (Aud.). 277

ANALYSIS OF PERFECT SPRING MALES.

- Tail feathers edged with yellow; head yellow *arstiva*.
 Tail feathers blotched with white; a white spot at base of
 primaries *ceruleascens*.
 —no white spot at base of primaries. (a)
 (a). Wing bars not white. Below, white; sides chestnut-
 streaked, crown yellow *pennsylvanica*.
 —yellow; sides reddish-streaked, crown reddish . . . *palmarum*.
 —black-streaked; above, ashy *kirtlandi*.
 olive, reddish-streaked . . . *discolor*.
 (aa). Wing bars white (sometimes fused into one large patch) (b)
 (b). Crown blue, like the back; below, white, sides and breast
 streaked *rara*.
 —chestnut, like the throat; below and sides of neck,
 buffy tinged *castanea*.
 —clear ash; rump and under parts yellow, breast and
 sides, black-streaked *maculosa*.
 blackish, with median line orange-brown, like the
 auriculars; rump, yellow *tigrina*.
 —perfectly black; throat not black; no yellow; feet flesh
 color *striata*.
 —with yellow spot; throat flame-color; rump not yellow *blackburnia*.
 —white; rump and sides of breast yellow *coronata*.
 (bb). Crown otherwise; throat black; back, olive; crown like
 back *virens*.
 —yellow; back, olive; no black or ashy on head *vigorii*.
 —ashy blue; cheeks black; eyelids white *dominica albilora*.

DIAGNOSTIC MARKS OF WARBLERS IN ANY PLUMAGE.

- Wing bars and belly yellow *discolor*.
 Wings and tail dusky, edged with yellow *arstiva*.
 Wing bars yellow and belly pure white *pennsylvanica*.
 A white spot at base of primaries (which is almost never
 wanting) *ceruleascens*.
 Throat definitely yellow; back with no green; belly white . *dominica albilora*.
 Bill extremely acute, perceptibly curved; rump (generally)
 yellow *tigrina*.
 Rump, sides of breast and crown more or less yellow; throat
 white *coronata*.
 Wing bars white; tail spots oblique, at end of two outer
 feathers only *vigorii*.
 Tail spots at middle of nearly all the feathers; rump and belly
 yellow *maculosa*.
 Wing bars brownish; tail spots square at end of two outer
 feathers only *palmarum*.
 Wing bars not very conspicuous; whole under parts yellow;
 back with no greenish *kirtlandi*.

Tail spots at end of nearly all the feathers; no definite yellow anywhere *rara*.
 Throat, breast and sides black; sides of head with diffused yellow; outer tail feather white, edged externally . . . *virens*.
 Throat yellow or orange; crown with at least a trace of a central yellow or orange spot; outer tail feather white edged externally *blackburnii*.
 Bill ordinary, and with none of the foregoing special marks . . . *striata*, or *castanea*.

Subgenus *PERISSOGLOSSA* Baird.

264. (650). *Dendroica tigrina* (Gmel.).

Cape May Warbler.

Adult Male.—"Bill very acute, conical and decidedly curved; back, yellowish-olive, with dark markings; crown, black; abdomen and tail coverts, yellow; rump, rich yellow; an orange-brown ear patch; a black loreal line; under parts, yellow; streaked with black on breast and sides; large white patch on the wings; three pairs of large white tail blotches. *Female*.—Similar, but lacking distinctive head markings; small wing patch and tail blotches; under parts, paler; bill and feet, black." (Nehrling, N. A. Birds).

Length, 4.70-5.65; wing, 2.85; tail, 2.15.

RANGE.—Eastern North America, from West Indies to Hudson Bay Territory. Breeds from Maine, northern Michigan and Minnesota, north. Winters in West Indies. Resident in Jamaica.

Nest, in coniferous trees, on tip of large limb, pendent; of evergreen twigs, grass or vines, fastened with spider's web, and lined with horse-hair. *Eggs*, 4; dull white, slightly ashen, irregularly dotted and spotted, usually most about larger end, with yellowish, reddish-brown and lilac; .67 by .49.

The Cape May Warbler is generally considered a rare bird everywhere. While this is true, and some years it is altogether absent, there are years when it is common and even abundant. In Indiana it appears as a migrant, perhaps more numerous in fall than spring. Its peculiar distribution is very interesting. It generally breeds farther north than the United States, yet, like the Myrtle Warbler, it is a resident in Jamaica and Hayti, where they breed among the mountains. With us, they appear with the later Warblers, seldom arriving before April 25, and usually after May 1, and some years remaining until the close of the latter month. The dates here given explain the early and late first arrivals: Bloomington, April 24, 1885, 1886, remained to May 5, 1886; Brookville, May 4, 1886, and 1892, May 6, 1897; Madison, May 23, 1888; Knox County, May 9, 1885; Terre Haute, May 4, 1887, May 11, 1890; Indianapolis, May 7, 1878;

Carroll County, May 8, 1885, May 22, 1883, May 29, 1894; Lafayette, April 28, 1896, May 21, 1895; Sedan, April 27, 1896, May 15, 1897; Chicago, Ill., May 4, 1895, May 13, 1886. In the fall they sometimes begin to reappear late in August, and are slowly passing southward through September, a few lingering until well into October. They appeared in the vicinity of Chicago, Ill., August 29, 1895, and remained until September 14. The next year they came August 20, and were seen September 21. In 1896, also, they appeared at Greensburg, Ind., September 22, and did not all leave until October 12. They were noted in the vicinity of Cincinnati, September 7, 1877, and September 22, 1878. The spring of 1885 they were very common in Knox County. On May 9, Mr. Ridgway took five specimens. In May, 1892, they were generally common throughout the State. Mr. J. E. Beasley, of Lebanon, says they were more common than he ever knew them. They were passing for three or four weeks, and he saw them almost every day he was out, but never more than two or three. Similar reports came from Lafayette, Greencastle, Wabash and Brookville. The spring of 1896 they were common near Chicago, remaining until May 27. That fall, also, they were very common in that vicinity, and were reported as being abundant at Greensburg, Ind. The fall of 1895 they were tolerably common near Chicago. In some localities they are said to frequent the tops of tall trees. Some years with us they are found upon the drier uplands, among the oak woods, where they usually keep among the lower branches or upon the high bushes and smaller trees. They are not very active, but keep persistently hunting insects. At other times, we find them among our orchards, even coming into towns, where they occupy themselves catching insects among the foliage and about the blossoms of all kinds of shade and fruit trees. May 6, 1897, at noon, I observed a Cape May Warbler among the cedar and apple trees in my yard at Brookville. It was very deliberate, but very industrious. The apple trees were in full bloom. It went over them from lowest limb to topmost branch, apparently visiting most of the blossoms. If it caught an insect every time it appeared to, it must have taken hundreds. Even the warm mid-day sun did not stop its work, and its little song only sounded the clearer when those of many other birds had ceased. Its notes seemed to run like *a-wit a-wit a-wit a-wit a-wit*, each pair of syllables repeated five times with moderate rapidity and in the same tone, with no inflection. To me it sounded louder a hundred feet off than it did at one-fifth that distance. This may have been due to the sound having been reflected by a building where I stood at the greater distance. At one time associated with it on the same tree

were three Baltimore Orioles. Each did its utmost in insect catching, and for a time none of them had time to sing; they were too busy at the noonday meal. From reports received, others have had similar experiences with this bird. Prof. King examined four specimens taken between September 6 and 22. With the exception of one ant, all the food they had eaten was beetles. One stomach contained ten beetles. These Warblers are very beneficial, and their efforts on behalf of the farmer and fruit grower entitle them to his regard and care.

In the fall they often frequent thickets, brier patches, overgrown fence-rows, and weedy roadsides, after the manner of Tennessee and Red-poll Warblers.

Subgenus *DENDROICA* Gray.

***265. (652). *Dendroica æstiva* (Gmel.).**

Yellow Warbler.

Synonyms, SUMMER WARBLER, SUMMER YELLOW BIRD.

“Adult Male.—Entire lower parts and head, pure, rich gamboge-yellow; breast and sides, boldly striped with rich chestnut or orange-brown; wings and tail, dusky, every feather edged with yellow; upper parts, olive-green, sometimes streaked with dusky; bill, dark, horn blue; feet, brownish. *Female.*—Paler yellow. the chestnut-rufous stripes, dull, few or wanting entirely” (Chapman).

Length, 4.50-5.25; wing, 2.35-2.65; tail, 1.80-2.10.

RANGE.—America, excepting southwestern United States and northwestern Mexico, from Guiana and Ecuador to Bering Sea and the Arctic Coast. Breeds from northern Mexico, north. Winters from Mexico, south.

Nest, in crotch of bush or low tree in rather open situation; of bark shreds, vegetable fibre, grass, moss, wool, hair and plant down, neatly and compactly woven together. *Eggs*, 4-5; bluish-white, spotted and blotched with different shades of brown; .70 by .50.

The Yellow Warbler is one of our best known and most abundant summer residents. It arrives as the buds on the apple trees are bursting into bloom. It is no unusual thing to awaken a warm spring morning, after a few days of cold weather, and find that in the night the grass has grown markedly, the naked limbs of the apple trees are clothed in green and decked in flowers. One can almost see things grow. While gazing upon the changed scene, a bit of bright yellow flits among the apple boughs and says “we-chee, chee, chee, chee-wee.” It is the Yellow Warbler. The warm spell has quickened his move-

ments and brought back a friend of other days. Mr. E. M. Kindle says it arrived in Brown County April 4, 1884. Its first appearance, early and late seasons, are as follows: Brookville, April 11, 1897, April 24, 1884; Bicknell, April 15, 1894; Greencastle, April 19, 1896, April 25, 1893; Muncie, April 21, 1894, April 24, 1893; Carroll County, May 4, 1885, May 8, 1884; Dekalb County, April 21, 1896, April 27, 1894; Plymouth, Mich., April 18, 1896, May 1, 1893, 1895; Chicago, Ill., May 1, 1895, May 8, 1897.

It will be observed that the first arrivals of this bird, like that of a number of others, is earlier in eastern Michigan than in Chicago. However, the bulk of the migrants arrive at the same Michigan places but a day or two ahead of Chicago. Some years the weather conditions are such that birds move forward over a great stretch of country with nothing to retard them. Other years, they advance and halt and again go forward, making their general advance very slowly. In 1896, the first Yellow Warbler was seen at Brookville April 16. The same day five were seen at Frankfort. That day the advance was noted at Plymouth, Mich., to be followed by others next day. April 18 a great bird wave appeared, bringing multitudes of Yellow Warblers to Brookville and Frankfort. They practically extended across the length of Indiana in two days. On the other hand, the first arrival reached Brown County in 1894, April 4; Brookville, April 20; Muncie, April 21; Greencastle, April 24; Waterloo, April 27; Plymouth, Mich., April 28; Wolf Lake, Ind., May 5. They begin mating very promptly when the females arrive, which is usually a few days later than the coming of the males. I have recorded mating April 21, 1887, and have found them nest-building May 2 (1886).

In 1883 I saw a nest with eggs May 19, and in 1882, May 23. Nesting continues through May and the most of June. The nests are most often built in orchards and lawns and in the smaller trees fringing streams. The Yellow Warbler is one of the most common victims of the Cowbird, but she has learned to outwit the parasite. When the Cowbird's egg is found in her nest, she has been known to cover it with another nest, and occasionally with a second, making three nests, one on top of the other. In the two lower ones are buried the Cowbird's eggs. Mr. E. R. Quick has such a nest, taken near Brookville, in the spring of 1878. After the young are able to fly with ease, these birds begin to desert the orchards and lawns. One by one, they disappear through July and early in August, until very few are left. Their disappearance is so gradual that few there are who note their going. No more unsatisfactory records are at hand of the fall migration of any birds than of this one. While some years most of them

cease singing and disappear in July, sometimes a few remain until early September. In 1894 the last were noted at Plymouth, Mich., and Greensburg, Ind., the same day, September 3.

It is very valuable in destroying the insects infesting the trees, shrubbery and gardens on our farms and about our homes. Among other forms, they are known to eat larvæ, beetles, wild bees, moths, flies, bugs, spiders and myriapods. Those taken in Prof. Forbes' well-known orchard infested with canker-worms were found to have made sixty-six per cent. of their food of these worms. Dr. A. K. Fisher also says they feed extensively upon the larvæ of elm beetles.

266. (654). *Dendroica cærulescens* (LINN.).

Black-throated Blue Warbler.

Adult Male.—Above, uniform dull, dark blue, sometimes with a few black streaks on the back; below, pure white; the sides of the head to above the eyes, a narrow strip across the forehead, chin, throat and sides of body, black; a white spot at base of the primaries; wings and tail, more or less edged with grayish-blue, the latter with a white patch on the inner web of each tail feather, except the middle pair. *Adult Female*.—Entirely different; above, dull olive-green, more or less shaded with blue; below, whitish or buffy, tinged with yellow; sides of head, dusky olive; the eyelids and a more or less distinct stripe over the eye, whitish; recognized by the white patch at base of primaries, which is, however, smaller than in male; spots on tail feathers also smaller or wanting.

Length, 4.70-5.50; wing, 2.50-2.45; tail, 2.05-2.25.

RANGE.—Eastern North America, from Guatemala and West Indies to Labrador. Breeds from Connecticut, New York, southern Ontario and Minnesota, north. Winters from southern Florida, south.

Nest, of strips of bark, grass and rotten wood, held together and lined with rootlets and bark; in upright fork of bush or sapling, 6 inches to 2 feet off ground. **Eggs**, 3-5; white or pinkish-white, marked with lilac and brown, most thickly at larger end; .69 by .52.

Although in some localities in the State this is considered a rare species, yet that, I am confident, is because of the year when the observations were made. In southwestern Indiana and in other localities where records have been kept for a series of years, the Black-throated Blue Warbler is generally a common migrant, though some years it is rare, and others, apparently, wanting. Still, however, birds have their preferences, and there are doubtless localities where it is not often found.

It is not among the early Warblers to arrive, seldom appearing before the first week in May, and is then found for a week or ten days. The earliest record I have of its first appearance is from Anderson, where Mr. C. P. Smith took it April 24, 1897. At Brookville it appeared April 26, 1881 and 1891, while in 1884 none were noted until May 14, which was the latest date I have ever seen them. It first appeared at Wabash April 27, 1892; Greensburg, May 4, 1895, May 7, 1893; Sedan, May 1, 1895, May 6, 1896; Lafayette, May 5, 1893, May 8, 1892 and 1897; Petersburg, Mich., May 3, 1897, May 5, 1888; Chicago, Ill., May 3, 1895, May 8, 1896.

While they may occasionally remain until the middle of May (Lebanon, Ind., May 16, 1894), throughout the State, in the vicinity of Chicago, they are sometimes found until near the close of the month (May 26, 1897, May 28, 1894). In the Whitewater Valley I have found they habitually frequent the upland woods, sometimes finding their way into orchards, but generally, if I want to find them, I go among the upland beeches, hickories, oaks and sassafras. There they frequent the lower branches or the taller undergrowth. They then occupy themselves chiefly with the insects on the tree trunks and larger branches.

The males are conspicuous, but the females are rarely seen. I have known them to come into towns and be found among the fruit and shade trees. They are very unsuspicious, permitting one to approach closely and watch their movements. They make many motions, but not great progress. As they move among the branches, the tail is slightly spread and carried on a level with the back.

Sometimes they seem songless, again every little while the song sounds forth. This may be expressed by the syllables *tswee-tswee-tswee-tswee*; usually four, occasionally but two or three, uttered close together with a stridulating effect, all in the same tone, with a slight rising inflection at the end of the last syllable. At a distance it sounds like *to-zee-zee-zee-é*.

In the vicinity of Brookville I generally find them common. They were particularly so in the springs of 1885, 1887, 1892 and 1897. The fall of 1893 it was probably the most common Warbler there (Ulrey and Wallace). In 1892 they were very common at Lafayette (L. A. and C. D. Test). In 1897 they were common in Dekalb County (Mrs. Hine). About Chicago they are often common, and were noticeably so in the springs of 1895, 1896 and 1897 (Blackwelder, Tallman). They begin to appear throughout the State some years, on their return journey, late in August, and remain until October 1, or, rarely, 9. The following dates will indicate this more explicitly: They arrived

at Chicago August 24, 1896, September 4, 1895; at Cincinnati, O., August 30, 1897; Brookville, Ind., September 3, 1893; Warren County, September 11, 1897. Last noted in Chicago, October 3, 1895 and 1896; Lake County, Ind., October 3, 1875, September 28, 1879; Lafayette, October 2, 1895; Sedan, October 9, 1894; Brookville, October 5, 1887. Sometimes in fall they are very common, just as they are in spring. Prof. King examined six of these birds, and all had eaten insects; one, two ants; five, beetles, and one, two caterpillars (Geol. of Wis., I., p. 503).

267. (655). *Dendroica coronata* (LINN.).

Myrtle Warbler.

Synonyms, YELLOW-RUMP WARBLER, YELLOW-CROWNED WARBLER.



Head of Myrtle Warbler. Natural size.

Adult Male.—Above, bluish-ash, streaked with black; under parts, white; the fore part of breast and the sides, black, the feathers mostly edged narrowly with white; crown, rump and sides of breast, yellow; cheeks and lores, black; the eyelids and a superciliary stripe, two bands on the wings, and spots on the outer three tail feathers, white. *Females*.—Of duller plumage and browner above. *Autumnal and winter birds* are very much duller and more obscurely colored, the upper parts of an umber cast, with the streaks almost obsolete; the black of the breast wanting, or but just indicated, and the yellow patch on crown almost concealed by the brown tips to the feathers; and those on side of breast quite dull (O. of Ill., Vol. I., p. 140).

Length, 5.00-6.00; wing, 2.75-2.85; tail, 2.20-2.30.

RANGE.—Eastern North America, from Panama and Greater Antilles to Arctic Coast, Greenland. Breeds from northern New England, Ontario and Minnesota, north. Winters from southern New England and Indiana, south. Resident in Jamaica.

Nest, of grass, fibres, vegetable down and feathers, compactly woven; in forest and coniferous scrub, on bush or tree, 5 to 10 feet from

ground. *Eggs*, 4-5; white, creamy-white or bluish-white, marked often about larger end with wreath of dark brown spots; .68 by .52.

The Myrtle Warbler is an abundant migrant, generally found in flocks, and is an irregular winter resident north to Brookville, Greensburg and Bloomington. The winters of 1882-3, 1886-7, 1891-2, 1894-5 they remained at Brookville, and, in addition, at Greensburg the winter of 1896-7 (Shannon), and at Bloomington the winter of 1885-6 (Evermann). Their winter range does not seem to be limited by the degree of cold, for some of our colder winters, when the thermometer registers below zero, they remain, and warmer winters are not observed. In winter they seek the protection of ravines, where thickets are, and of evergreens, even about residences and in towns. There they remain very close through the colder months. In February or March, as soon as a succession of warm days appears, they begin to move about to some extent, over the area of winter residence. I have never found one of them before April, where they did not sometimes winter. As the weather gets warmer, the numbers continue to increase up to the line of winter residence, possibly by reason of those a little farther south pushing north. Then in late March and early April they frequent the thickets fringing our streams. The migrations are very uniform. They do not really occur outside their winter homes until a number of other Warblers have arrived in southern Indiana, but every year they occur about the same time, and they usually move forward and possess the land at once; two, or at most a few days, sufficing to cover the State. One year is pretty much a repetition of others, and reference to 1897 will illustrate that point. They were first seen at Richmond, just beyond the known winter range, April 22. April 24 they appeared at Anderson, Carmel, Lafayette and Chicago, Ill., and April 25 they reached Petersburg, Mich. The dates next given are earliest and latest record of first arrivals: Greensburg, April 13, 1896, April 28, 1885; Greencastle, April 13, 1894; Richmond, April 22, 1897, April 29, 1890; Wabash, April 15, 1892, April 17, 1894; Lafayette, April 24, 1897, April 26, 1892; Sedan, April 24, 1894, April 29, 1897; Laporte, April 15, 1894, April 18, 1896; Chicago, Ill., April 12, 1884, April 27, 1897; Petersburg, Mich., April 21, 1889, May 1, 1893.

When they arrive in force, they are found in almost all kinds of places, even in the dense woodland, high up in the trees, where they were not before found.

"Their song," Mr. Ridgway says, "is somewhat like that of the Yellow Warbler, but is more of a warble and sweeter in tone. Their loud *tchip* and plain yellow markings, especially the yellow rump,

distinguish them." Other Warblers linger later than they. Most of them are gone from southern Indiana before May 5, though I have record for Brookville May 7, 1892, and from Greensburg, May 14, 1893 (Shannon). By the latter date they have generally passed our northern border. A few, some years, linger longer, especially about the lower end of Lake Michigan. Prof. Evermann found them in Carroll County May 22, 1883; Chicago, May 17, 1897 (Tallman); Wolf Lake, Ind., May 30, 1894 (Parker).

In the fall they begin to return the middle of September, and promptly spread across the State, remaining with us, frequenting woods, thickets and weed patches, even stubblefield overgrown with rag weeds, often associating with other Warblers and Sparrows. The first arrivals prefer the woods, and later they are noticed about the fields and orchards. The earliest of fall arrivals at Chicago is September 15, 1896; at Bicknell, Ind., September 18, 1894; Brookville, September 23, 1887. The last record from Chicago is October 3, 1896; Lake County, Ind., October 2, 1881; Carroll County, October 5, 1878; Lafayette, October 27, 1894; Brookville (where they did not winter), October 29, 1887.

The food of these Warblers is almost entirely insect food, and the fact that they are found during their visits in almost every conceivable situation, catching insects, renders them objects especially worthy of our regard. Of 21 of these birds examined, one had eaten a moth; two, twenty-one caterpillars, mostly measuring worms; five, fourteen flies; fifteen, forty-eight beetles; one, four ichneumons; one, a caddis fly; one, a spider, and one, fifteen tipulid eggs (King, Geol. of Wis., I., p. 503). The results of Prof. Forbes' investigations show the same kinds of foods.

268. (657). *Dendroica maculosa* (GMEL.).

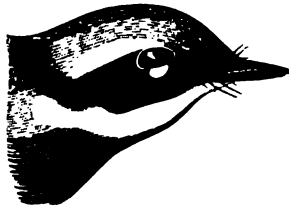
Magnolia Warbler.

Synonym, BLACK AND YELLOW WARBLER.

Male in Spring.—Back, black, the feathers more or less skirted with olive; rump, yellow; crown, clear ash, bordered by black in front to the eyes, behind the eyes by a white stripe; forehead and sides of the head, black, continuous with that of the back, enclosing the white under eyelid; entire under parts (except white under tail coverts), rich yellow, thickly streaked across the breast and along the sides with black; the pectoral streaks crowded and cutting off the definitely bounded, immaculate yellow throat from the yellow of the other under parts; wing bars, white, generally fused into one patch; tail spots,

small, rectangular at the middle of the tail and on all the feathers except the central part; bill, black; feet, brown. *Female in Spring*.—Quite similar; black of back reduced to spots in the grayish-olive; ash of head washed with olive; other head markings obscure; black streaks below, smaller and fewer. *Immature*.—Quite different; upper parts, ashy-olive; no head markings whatever, and streaks below wanting, or confined to a few small ones along the sides, but always known by the yellow rump in connection with extensively or completely yellow under parts (except white under tail coverts), and tail spots near the middle of all the feathers, except the central.

Length, 4.35-5.00; wing, 2.25-2.45; tail, 1.85-2.05.



Head of Magnolia Warbler. Natural size.

RANGE.—Eastern North America, from Panama and West Indies to Hudson Bay. Breeds from New Hampshire and northern Michigan, northward. Winters from Mexico and Bahamas, southward.

Nest, of twigs, weeds and grass, lined with fine rootlets; low in conifers. *Eggs*, 3-5; creamy-white, spotted or blotched with light and dark brown and lilac; .63 by .48.

The Magnolia is one of the most attractive of the Warblers. It is usually reported a common migrant in the Whitewater Valley. I have not found it so, yet in the more level and less drained portion of the State, they are reported oftentimes common. They are among the later kinds to arrive, rarely as early as April 21, and usually appearing after May 1. They linger in the southern part of the State some years until after the middle of the month, and along the northern border, in the vicinity of Lake Michigan, occasionally until the end of the month.

The following are the earliest and latest dates at which they were seen in the fall migrations: Brookville, first seen May 2, 1882, last seen May 16, 1884; Greensburg, May 4, 1893, May 16, 1894; Carroll County, May 4, 1878, May 24, 1883; Wabash, May 5, 1892; Carmel, April 24, 1897; Lafayette, May 13, 1893, May 14, 1892; Sedan, May 10, 1894; Lake County, May 18, 1885, May 30, 1894; Chicago, Ill., May 1, 1895, May 30, 1894; Petersburg, Mich., May 11, 1888, May

24, 1893. They come when vegetation is well advanced and the trees well in leaf. They prefer the more open woods and thickets, and there among the higher bushes, and lower branches of the trees, they quietly do their work. They are modest, retiring birds, though very striking in color and carriage. As they move leisurely about, with the tail partially erect and the feathers spread, the white patches on their inner webs are plainly visible. Its song, which is sometimes heard, is said by Mr. Langille to be "a loud, clear whistle, which may be imitated by the syllables 'chee-to, chee-to, chee-tee-ee,' uttered rapidly, and ending in the falling inflection." I have generally found them in maple woods, often near streams.

In the fall the advance migrants appear about the lower end of Lake Michigan the latter part of August, and sometimes reach the Ohio River almost as soon. Some years their stay is short; others, they remain a full month, departing the last days of September. They arrived in Cook County, Ill., August 31, 1895, August 21, 1896; at Lafayette, August 24, 1896; at Cincinnati, O., August 28, 1879. The last fall occurrences were at Chicago, Ill., September 27, 1895; Lafayette, September 26, 1896; Lake County, Ind., September 25, 1875, September 28, 1878, September 18, 1881. As with all this group of birds, this is very destructive to insects. Prof. King examined 17 specimens: Three had eaten four hymenoptera, among which were two ants; one, a moth; six, 17 caterpillars; six, 15 diptera, including two tipulids; six, 12 beetles, and one, 2 larvæ (Geol. of Wis., I., p. 505).

***269. (658). *Dendroica rara* (Wils.).**

Synonym, *DENDROICA CENULEA* (Wils.).

Cerulean Warbler.

Synonym, BLUE WARBLER.

Male in Spring.—Azure-blue, with black streaks; below, pure white; breast and sides, with blue or blue-black streaks; two white wing bars; tail blotches small but occupying every feather, except, perhaps, the central pair; bill, black; feet, dark. *Female and Young* with the blue glossed with greenish, and the white soiled with yellowish; a yellowish eye ring and superciliary line (McIlwraith, p. 365).

Length, 4.00-5.00; wing, 2.40-2.70; tail, 1.70-1.90.

RANGE.—America, from Bolivia north, over eastern United States to northwestern New York, southern Ontario, southern Michigan and Minnesota, west to Nebraska.

Rare east of Alleghanies. Breeds from West Virginia, Tennessee and Missouri, northward.

Nest, 20 to 50 feet high, 5 to 15 feet from body of tree, saddled to horizontal limb. Material, shredded bark of trees and vines, grass and vegetable fibre, lichens and spiders' webs on outside and lined with fine bark and grass. *Eggs*, 4-5; size .64 by .50; greenish-white, bluish-white or creamy, spotted with reddish-brown, russet and lilac chiefly at the larger end.

The Cerulean Warbler is a summer resident over most if not all of our State. In some localities it appears to be rare or wanting, and from others it has only been reported as a migrant. In southeastern, and I have no doubt in general, through the rougher land of southern Indiana, this is the most common tree-inhabiting warbler, both during the migrations and in summer. It is common and breeds throughout the lower Wabash Valley at least to Terre Haute and in Carroll County (Evermann). I have no doubt it does also in the picturesque Sugar Creek region in Parke and Montgomery counties, where we found it common May 19 and 20, 1887. At Brookville it breeds commonly. Messrs. L. A. and C. D. Test have noted it several times at Lafayette, once as late as May 30 (1892), but have not found its nest. It is tolerably common in Dekalb and Wabash counties, where it probably breeds. At English Lake it is rare, but one pair being recorded from there, May 20, 1888. Mr. J. G. Parker found a female with two young but a few days out of the nest along the Kankakee River near Kouts, Ind., sixty miles from Chicago, June 29, 1895.

In southern Indiana they usually arrive the last half of April, and by May 10 are often spread over the State. The following dates give earliest and latest dates of first arrival: Brookville, April 19, 1889, May 5, 1893; Monroe County, April 27, 1886; Carroll County, May 5, 1884, May 21, 1883; Wabash, May 4, 1892; Muncie, May 6, 1888; Lafayette, April 24, 1897, April 27, 1892; Dekalb County, April 24, 1891, May 12, 1892; Petersburg, Mich., April 27, 1888, May 10, 1893; Plymouth, Mich., May 3, 1891 and 1896, May 18, 1893. The males precede the females by from one or two days to a week, and always outnumber them greatly. At once, upon the arrival of the females, the season of courtship begins. I have observed them mating as early as April 26, and by the first week in May their time is largely occupied in choosing a mate. All does not go smoothly, however, for frequently more than one of the beaux has a very decided fancy for a particular belle. There is a meeting between the rivals, and frequently the battle is long and severe. So engrossed do they become at times that they fall, fighting, to the earth, unheeding everything around them. At this time the male is using his utmost effort to sing his sweetest songs. When he first came, his song was, *zee-zoo-*

see-e-e, the last syllable, sometimes the third, sometimes the fourth, trilled. It was not loud and shrill, but distinct, carrying to a considerable distance. It reminds me some of the songs of the *Helminthophilas*, approaching nearest to that of *H. chrysoptera*, and bears some resemblance to that of the Cape May Warbler. The song, however, changed. In eight to twelve days it was *tweet-tweet-twel-twee-ee*, ending with a trilling or twanging effect on a rising scale. At times, a part or the whole of the first song is added to this more pleasing effort. Within twelve to fourteen days after arrival, the differences have all been settled, all are happily married, the honeymoon has begun, and the most thrifty pairs are housebuilding. The Cerulean Warblers are, typically, birds of the treetops. Save when crouching in some sheltered valley, to escape a raw wind, I have seldom found them elsewhere than among the limbs of the tall maples, hickories and elms. There they spend their time, obtain their living from the many insects that infest the foliage, flowers and bark, and build their nests. The nests I have found were usually forty to sixty feet high, on top of a horizontal limb. The male evidently exhausted his strength in his efforts to overcome rivals and to show his attentions to his favorite. He now is not able to assist in building the nest. His wife does that, and he sings while she works.

May 6, 1897, I found a female so busily engaged nest-building that she had not time to stop. Evidently she had a time contract, and the limit was about up. She gathered fibres, spiders' webs and other building material from the bushes and brush piles all around me, and carried them to the horizontal limb, about fifty feet high, on an oak, some two hundred feet away. She scarcely had time to deposit her load, when she flew back for more material. I watched her a long time and was surprised at the great energy she exhibited. In southern Indiana, the eggs are laid the latter part of May, and the young are out of the nest the last half of June. About that time the song ceases.

In July, most of them leave, some lingering through August, occasionally even to the first of September. The latest dates I have are: Lafayette, August 22, 1892; Vermillion County, August 22, 1897; Plymouth, Mich., August 15, 1894, September 1, 1892.

While they are with us they frequent the wooded hillsides and the upland woods, as distinguished from the immediate river valley. They are not associated in flocks, but are evenly distributed through woods of the proper character. Their habits are such as make them of great service. Often, from among the high limbs of a tree, one will be seen to dart out and, flycatcher-like, seize flying insects; among the smaller

twigs and about the blossoms, they are like Vireos, examining both sides of every leaf, and the inside as well as the outside of every blossom; on the large limbs, they may be often mistaken for the Black and White Warbler, such adepts are they as creepers. Having all these traits, they are excellent general-purpose birds, as insect-catchers.

***270. (659). *Dendroica pennsylvanica* (LINN.).**

Chestnut-sided Warbler.



Head of Chestnut-sided Warbler. Natural size.

Adult Male.—Upper parts, greenish-yellow, streaked with black; crown, yellow, bordered with white, then enclosed in black; sides of head and under parts, pure white; lores, with a line through the eye and one below it, black; a conspicuous chestnut-brown stripe on the sides, starting in a line with the black mustache; wing and tail feathers, dark brown, edged with bluish-gray; wing bars, white, generally fused in one large patch. *Female*.—Similar, but less highly colored; black on head obscure, and chestnut streaks thinner and fewer (Nehrling, Pt. V., p. 215). *Immature*.—Different; above, continuous light olive-green; below, white; ring around eye, white; no black on head; sometimes a chestnut streak on the side; wing bars, clear yellow. The clear, yellow wing bars and white under parts distinguish birds in this plumage.

Length, 4.60-5.25; wing, 2.40-2.65; tail, 1.95-2.10.

RANGE.—Eastern North America, from Panama to Manitoba, Ontario and Newfoundland. Breeds from northern New Jersey, Illinois and the Alleghany Mountains, in Georgia, north. Winters from Bahamas and eastern Mexico, south.

Nest, in fork of bush, three to eight feet up, of bark shreds and grass, lined with plant down and hair. *Eggs*, 4-5; creamy-white, with markings of reddish and dark brown, chiefly wreathed about the larger end; .65 by .49.

A common migrant most years, but sometimes rather rare. In the extreme northern part of the State it is a summer resident; Laporte

County (Byrkit). Dr. A. W. Brayton says it "breeds sparingly in the north of the State." It is reported as breeding in Monroe (Trombley), Wayne (Alexander), Kalamazoo and Ingham counties, Michigan (Cook, B. of M., p. 132). It also breeds in northern Ohio, northern Illinois, and Mr. Robert Ridgway has found it in the breeding season as far south as Richland County, Illinois. They arrive a little later in spring than some of the species I have noted. While occasionally seen as early as April 24 (1881), usually they appear southward after May 1, and northward between May 5 and 10. First arrivals early and late years are: Knox County, April 24, 1887; Brookville, May 2, 1881, May 9, 1875; Carroll County, May 4, 1885, May 22, 1883; Wabash, April 28, 1892; Lafayette, April 27, 1892; May 16, 1897; Petersburg, Mich., April 28, 1889, May 11, 1893; Chicago, May 2, 1896, May 17, 1886. The latest I have taken it at Brookville is May 12, 1882. At Lafayette it has been taken May 28, 1892, and at Chicago, May 30, 1894. This Warbler is found in the Whitewater Valley, on the wooded hillsides and uplands. There it ranges from the ground to the tallest treetops, preferring the lower growths, in the heat of the day often seeking comfort and quiet in a cool thicket or a brush pile near the ground. As they move through the trees the wings are often partially raised and the tail somewhat elevated, indicating alertness and attention to its duties as one of the entomologists of our native forests. Where they make their summer homes they spend their time about the borders of woods and in second-growth timber. In New England, where they breed, they are said to frequent the more open woods and thickets away from cultivation. In Ontario, Mr. McIlwraith says it rears two broods. Its song somewhat resembles that of the Summer Warbler, but, once known, may readily be distinguished. Samuels says it consists of the syllables '*che-che-che-che-e-e*', and he mentions also a rattling cry, at times, which he compares to the alarm note of the Maryland Yellow-throat (B. N. E., p. 232).

In the fall they are more numerous than in the spring. While in spring the markings readily aided in determining the species, the imperfect markings in fall tend to confuse the novice. They are among the first migrants to appear in our latitude, sometimes arriving soon after the middle of August. While most of them leave before the last of September, they sometimes remain until after the 1st of October (October 3). In 1896 they first appeared at Lafayette August 18, and none were seen after August 27; whereas, in 1894, they had remained until September 4; Warren County, September 15, 1897; at Brookville, September 9, 1886; at Chicago, Ill., September 24, 1895,

and in Lake County, Ind., September 18, 1881, and October 3, 1875. In Wayne County, Michigan, they were last noted August 30, 1894.

They are said to eat canker-worms, flies, ants, caterpillars, tipulids, beetles, plant lice and grasshoppers.

271. (660). *Dendroica castanea* (WILS.).

Bay-breasted Warbler.

Adult Male.—Above, ashy-olive, thickly streaked with black; crown, chestnut-red; forehead and sides of head, black; wing bars, white; outer tail feathers with white patches at the tips; below, throat and breast chestnut-brown, lighter than the crown; rest of lower parts, buffy-white. *Adult Female*.—Above, olive, streaked with black, with less chestnut on the crown; below, with the chestnut fainter, sometimes only traces of it. *Immature*.—Above, light olive-green, more or less streaked with black; wings and tail marked much as in the adult; below, whitish, tinged with buffy; under tail coverts, with buffy tinge; sides of breast not streaked. Closely resembles immature of *D. striata*, which see.

Length, 5.00-6.00; wing, 2.75-3.00; tail, 2.15-2.25.

RANGE.—America, from Colombia north to eastern North America, Hudson Bay and Labrador; west to Iowa and Missouri. Breeds from northern Michigan and Maine, north.

Nest, in coniferous trees, in low woods, 5 to 20 feet up; of evergreen twigs, grass and lichens, lined with feathers and hair. *Eggs*, 4; bluish-green or bluish-white, spotted with brown, sometimes forming wreath about large end; .70 by .50.

The Bay-breasted Warbler is usually a very rare migrant in spring and is much more common in fall. Some springs it is wanting entirely, and many times, when present, but a single or, at most, a very few individuals will be seen in comparison with the numbers of other species that prefer the same woods. They arrive a little later than the Chestnut-sided. These two Warblers are always associated in my mind because the first specimen of each I shot were taken almost at the same hour, one spring morning, when almost all birds were new to me. They were new discoveries to a boy, to whom the high branches above became filled with flitting wings and a repetition of *t-sep* notes that plainly told of a world among the treetops, peopled by beautiful forms, unknown to the common run of mankind, who, though they have eyes and ears, neither see nor hear the inhabitants of that land. Their sight has not been quickened to see the unseen, nor their ears attuned to nature's harmony. She speaks not to them, because they

have no communion with her. These associations, these discoveries, that come to each one of us, are a part of life that mean nothing to any one save the individual concerned. To him they are much, for they are a part of his being—an experience in the unfolding of his powers that has been translated into consciousness.

They seldom reach our State before the first of May, the earliest record being from Knox County, April 30, 1881. They generally pass northward before the middle of May, by which time they have appeared throughout the northern counties, where they linger occasionally until May 20 or 25.

First appearances, early and late seasons, are: Brookville, May 2, 1884; May 12, 1882; Bloomington, May 4, 1886, Carroll County, May 4, 1886, May 5, 1884, 1885; Terre Haute, May 10, 1890; Lafayette, May 5, 1893, May 10, 1897; Petersburg, Mich., May 10, 1893, May 14, 1892; Chicago, Ill., May 3, 1895, May 15, 1897. They do not remain long, but pass rapidly through, the last remaining at Moore's Hill, Greencastle and Lafayette until May 13, 1893; Carroll County, May 22, 1883; Chicago, Ill., May 24, 1894; Petersburg, Mich., May 18, 1892.

In 1881, Mr. Ridgway found them very common for a few days in Knox County. In 1871, Mr. Aiken tells me they were rather common in Lake County. They were very common in Carroll County from May 5 to 20, 1885 (Evermann). They seem to have been generally observed in 1893 and were reported tolerably common that year at Greencastle, Lafayette and Moore's Hill. I have never heard it sing. Mr. Maynard says its song begins like that of the Blackpoll and has a terminal warble similar to that of the Redstart. To Mr. Langille's ear, it bears no resemblance to either, "but is a very soft warble, somewhat resembling the syllables *tse-chee*, *tse-chee*, *tse-cher*, *tse-chee*, *tse-chee*, but far too liquid to admit of exact spelling."

In habits, the Chestnut-sided Warbler and this appear to me much alike. This bird I have not found among the higher foliage of trees, preferring the lower branches and exhibiting a preference for the groves and more open woods rather than the denser forest. It is rather sluggish in its movements, as it assists in gleaning among the leaves and branches, the insect population of the trees in our pastures and more open woodland. In fall, they begin to appear early in September, and, while the greater part leave that month, some occasionally remain until late October. The earliest fall arrival in Lake County is September 2, 1883. They were last seen there September 28, 1879, October 3, 1875. Similar records show they arrived at Brookville September 7, 1886, were last seen October 9, 1879; at Lafayette, ar-

rived September 11, 1894, departed September 21, 1895; at Greensburg, Ind., last seen September 25, 1897; Cincinnati, O., arrived September 4, 1879; the fall of 1878 they were common until October 1, and the last departed October 20. In Indiana, they are much more regular in appearance, as well as more numerous, in the fall, sometimes being very abundant. The falls of 1894 and 1895 they were common at Lafayette (L. A. and C. D. Test). Prof. King notes that nineteen ate 7 ants, 7 lepidoptera, 6 diptera, 15 beetles, 6 leafhoppers and 1 dragon fly (Geol. of Wis., I., p. 497).

In the fall, when so many of these birds are in immature or imperfect plumage, it is very difficult to distinguish such birds from the next species. This species (*castanea*) is white below, tinged with buffy or creamy-buff, especially on the flanks, while the next species (*striata*) is clear, pale yellowish below. Dr. Langdon gives the following notes on distinguishing characteristics of these fall birds: "A comparison of specimens of both species shows that the chin, or feathered space between the forks of the lower mandible, is considerably wider in *castanea* than in *striata*, arguing a greater width of base of bill in the former species. The bill of *castanea* is generally the larger in every way, but its greater width at base is especially evident" (Jour. Cin. Soc. N. H., I., 1879, p. 171).

272. (651). *Dendroica striata* (FORST.).

Black-poll Warbler.

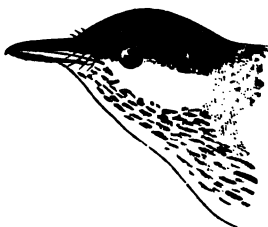
Adult Male.—Crown, deep black; other upper parts, grayish, streaked with black, the wings with two white bars; lower parts, including lower tail coverts, pure white; sides of throat, streaked with black, meeting on the chin. *Adult Female*.—Above, dull olive-green, everywhere streaked with black; beneath, whitish, tinged with yellow, the sides, and sometimes the sides of throat, with dusky streaks. *Immature*.—Above, brighter olive-green, not so distinctly streaked; below, more yellowish, sides not streaked; lower tail coverts, pure white.

Length, 5.00-5.75; wing, 2.80-2.90; tail, 2.05-2.25.

Note.—It is almost impossible to distinguish the immature plumages of this species and *D. castanea*. However, with close attention to three characters, they may be distinguished when other means fail. In *D. striata*, (1) the lower tail coverts are pure white; (2) the coloring of the lower parts is decidedly yellowish; (3) the sides of the breast are unstreaked. In *D. castanea*, (1) the lower tail coverts are buffy; (2) the coloring of the lower parts is buffy; (3) the sides of the breast are often indistinctly streaked with dusky.

RANGE.—America, from Colombia over eastern United States to Labrador, Alaska and Arctic coast; west to Rocky Mountains. Breeds from northern New England, northward. Winters from Cuba, southward.

Nest, in spruce trees, from ground to 10 feet up; of grasses, roots, lichens and spruce twigs, lined with grass and feathers. *Eggs*, 4-5, rarely 3; white, sometimes with creamy, grayish, greenish or pinkish tinge, marked with some shade of gray, usually olive, and usually spotted and speckled with burnt umber, russet or drab, heaviest at larger end; .71 by .50.



Head of Black-poll Warbler. Natural size.

The Blackpoll Warbler is usually the last of the tree warblers to arrive, and also, at times, is among the last to depart. It is an irregular migrant, generally rather rare, but some years common; usually most common in fall. They rarely reach our southern borders by April 27 (1888), but it is usually near the 10th of May when they should be expected, and at times much later than that. Whenever they come they often remain until after May 20, and, in the northern part of the State, occasionally until the last of the month. When these birds appear, some of the earlier Warblers have passed through. Their arrival is, to me, always a matter of note. I love to hail a bird whose business each year carries it half around the earth. Their deliberate ways are characteristic. It matters not whether it is in making their long journey from the Equator to the Arctic Circle, to build their home and rear their young, or in making a trip through the boughs of a maple tree, to gather insects for the morning meal—there is the same deliberation as though there was a studied effort to have every motion count. They seem to me directly opposite in character to the Black-throated Blue Warbler, which makes many motions for every stroke. Early and late first arrivals are: Vincennes, April 27, 1888; Bloomington, April 28, 1885; Terre Haute, May 4, 1887; Greensburg, May 6, 1895; Brookville, May 9, 1897, May 23, 1883; Lafayette, May 6, 1894, May 12, 1893; Richmond, May 19,

1897; Carroll County, May 21, 1883, 1885; Francisville, May 9, 1896; Lake County, May 16, 1897; Chicago, May 11, 1895, May 20, 1894.

Last spring records: Madison, May 23, 1888; Richmond, May 21, 1897; Lafayette, May 29, 1892; Lebanon, May 30, 1894; Lake County, May 30, 1894; Brookville, May 24, 1897. The spring of 1897 they were common at Brookville and Richmond; that of 1895 and 1896, in the vicinity of Chicago, Ill.; 1890, at Greencastle, Ind.; 1888, at Petersburg, Mich.

When with us, in spring, the males greatly outnumber the females. They are found in all kinds of woodland, at varying heights among the trees, but generally not very near the ground. Sometimes they visit the orchard and lawn, seeming to prefer evergreen trees. I have found them in ravines, among low bushes, uttering a *chip* now and then, while busy looking for food. Its song is the syllable *chi*, repeated five or six times—*chi-chi-chi-chi-chi*. The notes are staccato and are of equal length; the first is usually low, then rising until the two next, the last of which is loudest, the final one being lower than they. This is often uttered for a considerable time, with only a slight interval, punctuated by a *chip* between songs. Again, but occasionally will its song be heard, and there will be great breaks in the music. Often, when the foliage has become too dense to see the birds among the trees, this queer, pleasing melody will sound forth and tell us the author is in no haste to take his leave. In fall they return, to become a puzzle to the student of birds. The plumages of the young and females of this species and of the fall and immature specimens of *castanea* so nearly match that at times a serious question arises as to their identity. Under the last species has been indicated how they may be distinguished. At this season they may be observed, at times, following the custom of some other Warblers and frequenting the fencerows, roadsides and weedy stubble. They first appear about the lower end of Lake Michigan late in August. The bulk pass through in September, but some are at times found into early October. First and last dates when they were noted in the fall indicate the extent of their autumnal visits: Chicago, Ill., August 25, 1885, September 21, 1896; Lake County, Ind., September 2, 1883, September 25, 1875; Sandusky, O., last, October 4, 1896; Brookville, September 21 to October 13, 1883; Greencastle, September 28, 1890. Their numbers are greater in fall, and some years they are abundant. They were common at Brookville in the fall of 1883; at Bicknell, September 6 to 17, 1894; in the vicinity of Chicago, August 25 to September 5, 1885, and August 29 to September 21, 1896.

Four specimens were examined by Prof. F. H. King. They had eaten a caterpillar, 3 beetles and, it was estimated, 13 other insects. They are also said to eat canker-worms.

273. (662). *Dendroica blackburniæ* (Gmel.).

Blackburnian Warbler.

Adult Male.—Above, including wings and tail, black; wing patch, white; back, variegated with white; several lateral tail feathers, mostly white; crown spot, eyelids, line over the eye, throat and breast, brilliant or flame color, contrasting beautifully with the black surroundings; sides, streaked with black. *Female*.—Black of upper parts replaced by brownish-olive, with black streaks; flame color replaced by yellow; two white wing bars. *Immature*.—With the markings still paler, almost buffy, the crown patch very faint; above, brownish.

Length, 4.25-5.50; wing, 2.50-2.80; tail, 1.90-2.10.

RANGE.—America, from Ecuador north over eastern United States, etc., to Labrador; west to Manitoba, Utah and New Mexico. Breeds from South Carolina north along the Alleghany Mountains, and Massachusetts and Minnesota, northward. Winters from Bahamas and eastern Mexico, southward.

Nest, in pine or hemlock tree, 8 to 60 feet from ground, 10 feet out from trunk, on horizontal limb; of hemlock twigs, rootlets, bark, pine needles, moss, loosely woven, lined with horsehair, feathers and grass. *Eggs*, 4; greenish-white, spotted and blotched everywhere, but most thickly at larger end, with different shades of purple and brown, almost black in some instances; .69 by .51.

This beautiful warbler is a regular migrant, varying, as all the Warblers do, in numbers. They are generally common, some years abundant. This is one of the second early Warblers, coming as the maples and elms are putting forth small leaves, and while the hickories and oaks are still bare. They frequent trees, usually spending most of their time among the higher branches, but at times with other Warblers, busying themselves lower down among the foliage. They are generally associated with Black-throated, Green and Chestnut-sided Warblers. The earliest record I have of its spring arrival at Brookville is April 15, 1887, the latest May 7, 1875 and 1892. For the following places: Richmond, April 22, 1897; Greensburg, April 27, 1885, May 14, 1893; Greencastle, May 6, 1873; Bloomington, April 21, 1885, April 27, 1886; Carroll County, April 28, 1885; Lafayette, April 29, 1893, May 8, 1897; Waterloo, April 30, 1897; Chicago, Ill., April 29, 1886, May 18, 1897; Petersburg, Mich., May 5, 1889, May 16, 1888.

The dates at which they were last seen in spring are Brookville, May 11, 1882; Richmond, May 19, 1897; Carroll County, May 24, 1883; Lafayette, May 21, 1892; Lake County, May 30, 1894. Their breeding ground begins not far north of us, and from the time the last ones leave until the first fall migrants appear, with their faces turned the other way, is but a few weeks less than three months. They may even be found breeding in this State, as they are reported to have bred in Kalamazoo County, Mich. (Cook, B. of M., p. 133). They begin to arrive from the north after the middle of August—Chicago, August 21, 1886; Cincinnati, August 30, 1877; Vermillion County, Ind., August 19, 1897 (Barnett); and through the next month or six weeks are to be found frequenting the same kinds of woods they did in spring. Usually all have passed by October 1, but they are sometimes to be found after the middle of that month (Brookville, October 14, 1889; Cincinnati, October 18, 1879). They are the first of the migrating Warblers to arrive in numbers in the fall, and although the brilliant colors of the spring have been replaced by plainer hues, they may be recognized. At that season, they are usually much more numerous than they are in spring. As they return in the fall, they are silent, having lost the song they sang the preceding spring. Mr. Minot likens that song to the syllables *wee-see-wee-see, tsee, tsee. tsee, tsee, tsee, tsee*, the latter notes ascending in the scale until the last one becomes shrill and fine. In summer he says it sings, *wee-seé-wee-seé-wee-seé (wee-seé-ick)*. Their food consists of beetles, caterpillars, ants, bugs, crane flies, ichneumon flies, and other insects (King, Geol. of Wis., I., p. 504). They pass southward to their winter quarters, where great numbers of the brighter birds fall victims of the plumage gatherer. They are found in this northern land again, but not freely flitting among the greening trees, now showing their beautiful throats, then singing their queer little songs, but as articles of adornment, with other native birds. Their appearance upon the apparel of our women serves as a continual reminder of what a fearful offering of life the great Goddess of Fashion yearly demands at our hands. Upon her altars are sacrificed annually an innumerable host of man's good friends, the insect eating birds.

274. (663a) *Dendroica dominica albilora* RIDGWAY.*Sycamore Warbler.**

SYNONYM, WHITE-BROWED, YELLOW-THROATED WARBLER.

Adult.—Sexes alike; above, blue-gray, the back not streaked; a line over eye, yellow in front; white behind; sides of neck and two wing-bars, white; forehead, sides of head and sides of neck and streaks on sides of body, black; throat, yellow; other lower parts, white.

Length, 4.50-5.50; wing, 2.50-2.65; tail, 2.00-2.25; bill, .45-.48.

RANGE.—Eastern North America, from Honduras; north in Mississippi Valley to Kansas, Indiana, Michigan, West Virginia and Ohio; east to North Carolina. Breeds from Texas and Mississippi, north. Winters from lower Rio Grande Valley, south.

Nest, in fork, far out on a high limb, usually of a sycamore.

The Sycamore Warbler is a common summer resident along the streams of southern Indiana, where timber containing sycamore trees is found. It is very common, particularly in the spring, along the White-water River as far up as Brookville. There, but few ascend the east fork of that stream, and it is consequently rare at Richmond, while it is common along the west fork to Laurel, and has been taken at Connersville. It is common up the Wabash Valley to Park and Montgomery Counties, where I found it May 19 and 20, 1887, along the Valley of Sugar Creek, and to Carroll County; also up the White River Valley to Indianapolis. Higher up the Wabash they are rare and, perhaps, in some places, of accidental occurrence. They have been reported during the breeding season from Greencastle (Hughes, Earle), and Lafayette (L. A. and C. D. Test), where they are rare, as they also are at Ft. Wayne (Stockbridge). They range north into Michigan, where, in Monroe County, they were reported tolerably common to 1887, but are now rare (Trombley), and to the vicinity of Detroit. They also cross Ohio, being tolerably common as far as Columbus (Wheaton), and are found near Cleveland (Forest and Stream, Vol. VI., 1876, p. 300). They have not been found in the Kankakee Valley, or north of it, in this State, yet it has been noted rarely in northern Illinois. The coincidence of the range of this species with that of the Cerulean Warbler is notable. Yet they occupy entirely different ground, thus complementing each other. The Sycamore Warbler does not depart from the vicinity of streams, even following small creeks, along which sycamores grow, for quite a distance towards their source. They seem to prefer these trees, spending much time among their highest branches, but they may also be found among all the trees fringing waterways, sometimes quite near the ground, and

often are seen among our orchards, lawns, and even the shade trees along the streets of towns in the valleys. They never enter the woodland. There, on the contrary, the Cerulean Warbler prefers to make his home, especially among the woods of the hillsides and uplands. The song of the Sycamore Warbler, as I catch it, is as follows: *Twit, che-e, che-e, che-e, che-e, che-e, che-á*. This is about its usual length. The first syllable is abrupt, with rising inflection, then, after a slight pause, the remainder is uttered at the same pitch until the last syllable, which ends sharply with a slight rise in tone. The whole song is very unique. Its notes are clear and distinct, and it is pitched in such a key that it may be heard under favorable circumstances over a quarter of a mile. They arrive very early in spring, being one of the very first Warblers to attract one's attention, and they usually become very common at once.

Its longer flights much resemble those of the Chipping Sparrow. Its shorter ones, as with quivering wings it beats rapid strokes when moving from limb to limb, remind one of the movements of the Kingbird.

The dates of early and late first arrivals are: Brookville, April 3, 1882, April 27, 1895; Knox County, April 17, 1881; Bloomington, April 14, 1886; Terre Haute, April 14, 1888; Richmond, April 16, 1888; Greencastle, April 22, 1893, May 7, 1892; Lafayette, April 25, 1896; Carroll County, April 20, 1884, May 9, 1883; Wabash, April 28, 1892; Petersburg, Mich., April 17, 1889, April 28, 1893.

Evidently they push on without delay to their most northern breeding places. I have noted them mating April 22 (1881) and May 19 (1882) I obtained a specimen containing an egg ready to be laid. I found no description of its nest. Late in summer they may be seen among the orchards more than in the spring. I have never observed one at Brookville later than September 25, but in the northern part of the State and in Michigan they have been reported in October. I am under obligations to Mr. Jerome Trombley, of Petersburg, Mich., for the interesting account of his experience with this bird here given. It may be sought under similar conditions in northern Indiana:

"The Sycamore Warbler is a rare summer resident in Monroe County, Mich. It is the first of the Warblers to arrive in the spring, appearing here some years as early as the 20th of April. The Louisiana Water Thrush, another species of the same family, however, arrives about the same time, if not earlier. The favorite haunts of the Sycamore Warblers are in the wooded bottom lands along Raisin River, confining themselves principally to the tops of the huge sycamore trees which skirt the banks of the stream. They very rarely

descend lower than 25 or 30 feet from the ground. I have shot these birds when they were at a height of 90 feet, and appeared from below not much larger than Humming-birds, but their creeper-like habits render them easy of identification. The constant habit of remaining at such heights, coupled with extreme restlessness, make them one of the most difficult species to secure.

"The song is quite loud and spirited, and can easily be heard and distinguished at a distance of 300 or 400 yards. Some authors state the song resembles that of the Indigo Bunting. By others it is likened to that of the Black and White Warbler, or to the Pine Warbler's. The fact is, according to my experience, the song is a very characteristic one, and bears no resemblance to anything I have ever heard the above mentioned birds utter. It may be expressed by the syllables, *tee-o, tee-o, tow-tee*, accented on the syllable *tee*, with a rising inflection on the final syllable. The song is repeated at intervals of 10 to 15 seconds, and kept up for an hour or more. They remain but a few moments feeding or singing in the same tree, but are off to another, and after making the rounds of several trees, will perhaps be back in the first tree at the end of 15 or 20 minutes. My greatest desire in regard to this interesting little bird has been to secure a nest and its complement of eggs, but am sorry to say that, so far, I have been unsuccessful.

"I can therefore say but little of the nesting habits. For three or four successive years, I searched long and diligently, examining the tree tops, as well as I could from the ground, hoping to discover a nest, and had come to the conclusion that I would never succeed. Fortunately, on the 10th of May, 1880, I chanced to see one of these birds alight on the trunk of a tree, with building materials in its bill. In a few moments it flew to the top of a large sycamore, and then near the end of a small horizontal branch, where at last I had the pleasure of locating the long looked-for nest. I estimated the height from the ground to be somewhere between 60 and 75 feet, and on the end of a branch 20 feet from the trunk. The branch would not bear a weight of over fifty pounds, and with trunk of the tree 7 feet in diameter at the base, the first limb being 40 feet from the ground, I made up my mind that this nest was simply unattainable, except by extraordinary means. The next day I returned, and, with the aid of a good field-glass, I discovered that the nest looked as if nearly completed, and the birds were at work, apparently, putting in the lining. It was placed in the fork made by two smaller branches springing up from the branch on which the nest rested. I was unable to determine the materials which composed the nest, which appeared

about the size of that of the Cerulean Warbler. The identity of this nest was ascertained beyond a doubt. A good view was had of the female when first seen carrying the materials for building; also on the next day with the glass, while she was at work on the nest. The well-known song of the male was heard in the vicinity all the while that nidification and incubation was going on.

"The above article was written several years ago for a friend, who desired me to give him some information from my observations of the family of Warblers in this locality. I have been able to add but little of interest since in regard to the Sycamore Warbler. As the timber is being cut from the bottom lands, they have become much rarer than formerly. I am not positive that I saw more than a single bird this year, 1897. In the swamps, away from the river, where sycamores grow plentifully, I have sometimes come across a few of these birds, and I believe they nested there, as they were seen or heard as late as July. This species departs for their winter habitat along the last of September, or the first of October, as I have never been able to detect their presence later than the 10th of October.

275. (667). *Dendroica virens* (GMEL.).

Black-throated Green Warbler.

Adult Male.—Above, bright olive-green; wing, crossed by two white bars; line over the eye and side of face, gamboge-yellow; chin, throat and breast, deep black; belly, white. *Adult Female*.—Similar, but black markings more or less broken by yellow or whitish. *Immature*.—Similar to female; black markings almost replaced by yellow.

Length, 4.35-5.40; wing, 2.40-2.55; tail, 1.90-2.05.

RANGE.—Eastern North America, from Panama and Cuba, northward to Hudson Bay, straggling to Greenland and Europe. Breeds from South Carolina, northward along the Alleghanies. Common, northern Ohio and northern Illinois and Michigan, northward. Winters from Cuba and Mexico, southward.

Nest, in woods, usually on horizontal branch of coniferous bush or tree; 2 to 50 feet up; of bark, grass, twigs, fibres, feathers; lined with down. *Eggs*, 4; white or creamy-white, spotted with burnt umber or russet, and purplish-gray, usually arranged in wreaths about larger ends; .64 by .48.

The Black-throated Green Warbler is a very common migrant. Few among the Wood Warblers, perhaps none, are as well known as this. It comes after the earliest ones have renewed their acquaintance, and is one of several that seem to be associated at this season. It spends

its time here among the larger trees in woodland, both wood pastures and forests. There among the foliage, from lowest limb to topmost bough, it may be found, in company with Blackburnian and Chestnut-sided Warblers. Occasionally they are found among the orchard trees. They arrive southward from April 22 to May 8, and about the northern boundary May 1 to 10. Early and late dates are Brookville, April 26, 1881, 1886, and 1893, May 8, 1882; Greensburg, April 26, 1893, May 13, 1894; Lafayette, April 27, 1892, and 1893, May 6, 1897; Carroll County, April 28, 1885, May 5, 1894; Sedan, April 24, 1894, April



Black-throated Green Warbler. Natural size.

30, 1896; Lake County, May 11, 1884; Chicago, Ill., May 1, 1896, May 6, 1886; Petersburg, Mich., May 2, 1888, May 9, 1897. If they arrive early, they usually remain from one to two or three weeks, but if they are late coming they pass through rapidly. The latest date for southern Indiana is May 13, 1894 (Greensburg); for northern Indiana, May 24, 1879 (Lake County). Some unusual records have been made by Messrs. Dury and Freeman at Cincinnati, O. The earliest arrival is April 22, 1878, and he noted them there July 23, 1879, and says: "They were somewhat common about July 30, 1879" (Journ. Cin. Soc. N. H., July, 1879).

It breeds in Michigan, south to Montcalm and Kent Counties (Cook, B. of Mich., p. 134), and has been reported as breeding in northern Illinois (W. W. Cooke), and northern Ohio (Wheaton). Its song is very peculiar, and cannot be mistaken for that of any other bird. Mr. John Burroughs has expressed its notes by three straight lines: —

— v —.

In fall they are abundant, frequenting every kind of woodland from second-growth to virgin forest. While they are changed some in appearance from the previous spring, they may readily be recognized. They first appear, a few of the vanguard, late in August, and remain until after October 1. First arrivals: Vermillion County, August 23, 1897; Lafayette, August 27, 1896; Lake County, September 2, 1883; Wabash, September 11, 1892; Brookville, August 29, 1887. Last records: Lake County, October, 1881; Chicago, October 5, 1894, and 1895; Lafayette, October 5, 1895; Brookville, October 8, 1884, and 1885. The Black-throated Green Warbler is the most even in its dates of migration of any of the genus. This is distinctly shown when one examines a series of dates, running over a number of years. Their food is practically the same as all of the family—large numbers of insects. Prof. King found that of twelve specimens examined, one had eaten a moth; three, seven caterpillars; three, eleven beetles; and one, two diptera; one, six larvæ, probably caterpillars, and one a heteroptera (Geol. of Wis., I., p. 502). Prof. Forbes has ascertained they eat hymenoptera, caterpillars and curculios. Their woodland habits, and also those of other species, while beneficial, are not so noticeably of value as they would be if they frequented our fruit and shade trees more. Doubtless, with the lessening of our wooded area and the increase of acreage in orchards, they will more and more be found there.

276. (670). *Dendroica kirtlandi* BAIRD.

Kirtland's Warbler.

Adult.—Above, bluish-gray; back, more brownish and streaked with black; lores and narrow frontal band, black; no white wing bars; a white spot on each eyelid; below, pale yellow; sides of throat and of body streaked with black. *Adult Female*.—Similar, but paler.

Length, 5.30-6.00; wing, 2.60-2.90; tail, 2.25-2.50.

RANGE.—From Bahamas, northwest over southeastern United States, migrating through eastern part of Mississippi Valley and western Lake region. Breeding range unknown. Winters in Bahamas.

Nest and Eggs, unknown.

Kirtland's Warbler is a very rare bird, known from but a few localities in the United States as a migrant.

The first specimen known from Indiana was taken at Wabash, by Mr. W. O. Wallace, May 4, 1892.

Mr. Wallace says: "I took it in a thicket. It was alone, there being no other birds in the near vicinity of it. It seemed to be an

active fly-catcher, not having the motions of the other *Dendroica*, being less active. It would dart off after an insect and then return to the same perch." Mr. Wallace has kindly placed this specimen in my collection.

Mr. Wallace took another specimen May 7, 1895. He says: "Early in the morning I heard a bird singing in the thicket of plum trees near the house. The song was strange to me, and consisted of a loud, ringing note, repeated three times in quick succession. The song bears considerable resemblance to that of the Great Carolina Wren, and also suggests that of the Maryland Yellow-throat. It is loud and rather musical. I did not go to look for it at once, but as it continued singing for some time, I finally got my gun and went to look for it. It had flown over into the orchard then, but soon returned to the plum thicket, and was constantly uttering its peculiar note. Had it not been for its loud and peculiar song, I should have pronounced it a Canada Flycatcher. Its song sealed its fate. After watching it catch insects and listening to its song for some time, I backed off and shot it. Imagine my surprise when I held in my hand my second Kirtland's Warbler."

The species was described from a specimen taken by Dr. Kirtland near Cleveland, O. The following are the reported records of its occurrence:

1. At sea, off Abaco, Bahamas, by Dr. Samuel Cabot, second week in October, 1841.
2. Near Cleveland, O., by Dr. J. P. Kirtland, male, May 15, 1851. Type specimen.
3. Near Cleveland, O., by R. K. Winslow, female, June, 1860.
4. Near Cincinnati, O., by Charles Dury, male, first week in May, 1872.
5. Ann Arbor, Mich., by A. B. Covert, female, May 15, 1875.
- 6, 7. Rockport, Cuyahoga County, O., by Wm. and John Hall, May, 1878.
8. Andros Island, Bahamas, by Charles B. Cory, female, June 9, 1879.
9. Ann Arbor, Mich., by A. B. Covert, female, May 16, 1879.
- 10, 11. Cleveland, O., reported by Dr. Langdon, male and female, May 4, 12, 1880.
12. Battle Creek, Mich., male, May 11, 1883, now in United States National Museum.
13. St. Louis, Mo., May 8, 1885, Otto Widmann.
14. Spectacle Reef, Mich., May 25, 1885, Wm. Marshall. Struck the light at Spectacle Reef lighthouse.

15. Near Dublin Gap Springs, Pa., June 25, 1885, Prof. H. J. Roddy. He says: "Saw one with family."

16. St. Helena Island, S. C., April 27, 1886, Walter Hoxie. Reports seeing others.

17. Near Fort Meyer, Va., September 25, 1887, Wm. Palmer. Another seen a week later.

18. Ann Arbor, Mich., April or May, 1888, female, by Mr. Knapp.

19. Chester, S. C., female, October 11, 1888, L. M. Loomis.

20. Near Minneapolis, Minn., May 13, 1892, male, H. M. Guilford.

21. Wisconsin, Dr. P. R. Hoy. Reported seen.

22. Wabash, Ind., May 1, 1893, W. O. Wallace.

23. Wabash, Ind., May 7, 1895, W. O. Wallace.

In addition, it has been reported by Mr. C. S. Maynard, but I do not have the references at hand.

The winter home of this rare and narrowly restricted species is apparently the Bahama Islands. It has been taken most commonly during the spring migrations, near Cleveland, O., and Ann Arbor, Mich. It has never been taken in the interior of the United States during the fall migrations. The summer home of this Warbler would seem to be northern Michigan and Wisconsin, or north thereof, and possibly in the mountains of Pennsylvania. The line of its spring movements seems to be a narrow route from the Bahamas past the western end of Lake Erie toward Lake Superior. Perhaps the return migration may be over the same route, but it is possible this may be, in the whole or in part, farther to the eastward, passing down the coast after it reaches the Atlantic.

Its distribution is very remarkable. Yet there seems to be an effort on the part of other species to follow a line remarkably similar to that noted. From the northwest into South Carolina, even to the coast, there seems to be a migration route analogous to this. Along it would seem to move, in a southeasterly migration, such forms as Brewer's Blackbird, Yellow-headed Blackbird, Le Conte's Sparrow, Prairie Horned Lark, typical plains forms.

***277. (671). *Dendroica vigorsii* (Aud.).**

Pine Warbler.

Synonym, PINE-CREEPING WARBLER.

Adult Male.—Above, bright olive-green, more or less dulled by ashy; wings and tail, grayish; two wing bars, whitish; stripe from bill to eye and ring around eye, yellow; below, yellow, sides indistinctly streaked with dusky; lower tail coverts and more or less of the belly,

whitish. *Adult Female*.—Above, dull olive-gray, more or less tinged with olive-green; wings and tail as in male; ring around eye, yellowish; below, whitish, shaded more or less with grayish, the throat and breast showing yellow.

Length, 4.95-5.60; wing, 2.70-3.00; tail, 2.10-2.45.

RANGE.—Eastern North America, west to Plains; from the Bahamas north to New Brunswick, Ontario and Manitoba. Breeds throughout most of its range. Winters from North Carolina and southern Illinois, south.

Nest, in pine trees, 20 to 80 feet from ground, on horizontal limbs, 2 to 12 feet from trunk; of grapevine bark, closely woven, often with cocoons on outside. Inside lined with fine grass, horsehair and feathers. Average nest, 1.70 outer depth, 2.80 outer diam.; 1.45 inner depth, 1.55 inner diam. *Eggs*, 4-5; grayish or bluish-white (rarely pinkish-white), spotted distinctly and obscurely with chestnut and lilac-gray, often forming wreath at larger end; .70 by .53.

As its name indicates, this is a bird of the pines. But a name does not always mean what it says. Among the *Helminthophilas* is a *pinus*, which, perhaps, is so named because it never is found about the pines. Likewise, and among this, a Prairie Warbler that does not inhabit the prairies. Then, too, our joyous little Goldfinch, bubbling with pleasant emotions that involuntarily come forth as it rides the waves of the wind currents, has been burdened by the sorrowful name *tristis*.

In Indiana, the Pine Warbler is generally found as a rare migrant, though the spring of 1879 it was rather common. In a few localities, preferably where pines are native, a few spend the summer. Mr. J. W. Byrkit informs me it is a summer resident near Michigan City. Mr. E. W. Nelson says: "The first of July, 1874, I found a large number of these birds, with young just old enough to follow their parents, in the 'Pinery,' and presume they nest there regularly" (Birds N. E. Ill., p. 100). Dr. A. W. Brayton further adds: "Nelson found both old and young in the pine barrens, Lake County, where they undoubtedly bred regularly" (Proc. Ind. Hort. Soc., 1879, p. 108). Mr. Robert Ridgway informs me of its breeding in Knox and Gibson counties. It may be found to breed wherever native pines are found, as it is known to breed nearly throughout its range at different dates; the season beginning in South Carolina in March and in Manitoba in June.

It is among the early migrants, arriving some years by the middle of April, and not lingering where it does not breed after early May.

They arrived at Brookville, April 15, 1879 and 1882, May 3, 1883; Knox County, April 19, 1881; Richmond, April 25, 1897; Lafayette, April 27, 1892, April 29, 1893; Carroll County, April 29, 1885; Wabash, April 27, 1894, April 30, 1892; Michigan City, April 24, 1884. At all these places, except as first mentioned, they are very rare. The latest dates reported are May 1, 1892 (Lafayette); May 1, 1897, May 3, 1883 (Brookville). In the Whitewater Valley they frequent the wooded hillsides, where sugar maple is the prevailing timber. In such places, usually high up among the branches of the sugar trees, I have often found them. At times they nimbly flit from twig to twig among the unfolding leaves; again they pursue the habits of a creeper, reminding one of the Sycamore or Black and White Warbler, when insect hunting along the larger limbs and about the trunks of trees.

Often they arrive before the leaves have burst the buds, and then they play creeper to perfection. In spring, when they are with us, they have a Sparrow-like song. This has been compared to the song of the Chipping Sparrow, of a Junco, to the trill of the Swamp Sparrow, and to the well-known chant of the Field Sparrow. At any rate, it is a Sparrow's trill that comes to one from the highest boughs of the maple woods, where no Sparrow ought to be. In fall they only utter a chip as they pass southward, in September and October. The following are records of their fall appearance: Lake County, September 8, 1874; Warren County, September 15 and 16, 1897, September 25, 1878; Brookville, October 12, 1885; Richmond, October 15, 1887. They eat some seeds, but principally insects, including both those that infest pines and deciduous trees and those that frequent the branches as well as the foliage.

278. (672). *Dendroica palmarum* (GMEL.).

Palm Warbler.

Synonym, RED-POLL WARBLER.

Adult.—Above, dull olive-brown; crown, chestnut, a yellow stripe over the eye; back with indistinct streaks; rump, olive-green; wings, edged with olive-gray, not barred; below, yellowish, bright yellow on throat and under tail coverts; rest of under parts, washed with whitish and streaked with brown; two outer tail feathers with large white spots, sometimes a small one on the third. *Immature*.—Chestnut of crown, faint or wanting; line over eye and ring around eye, whitish; below, dull buffy, slightly tinged with yellow and streaked with dusky; lower tail coverts, yellow.

Length, 4.50-5.50; wing, 2.35-2.65; tail, 2.05-2.45.

RANGE.—North America, from Mexico and Greater Antilles, north through the interior of the United States, between Alleghany Mountains and Great Plains, to Mackenize Valley (Ft. Simpson). Rare on Atlantic Coast. Breeds far north. Winters from South Atlantic and Gulf States southward.

The Palm Warbler occurs only as a migrant in Indiana. In the western and northwestern parts of the State—the original prairie region—it is very common, often very abundant; much more numerous in spring than in fall. There it frequents the open fields, the fence rows and the roadsides, and to the naturalist, at least, is a very familiar bird. Throughout the southeastern half of our State it is of irregular occurrence, never abundant, and seldom, if ever, really common. From most places it is reported as rare, not common, or tolerably common. There it frequents thickets and fence rows, open fields and woods, being found at times in the deepest forests. In the woods it usually is seen among the bushes and lower limbs of trees, not over twenty feet high, but I have taken it at twice that height.

In the Whitewater Valley, some years it is very rare, and I have never found it common. In its migrations it not only seems to prefer the prairie district, but appears there earlier than farther to the eastward. In Illinois and western and northwestern Indiana the same year they appear earlier than in the southeastern part of the State, arriving in the vicinity of Chicago often as soon, or sooner, than at any station one hundred and fifty to three hundred miles southeast of there. In 1897 they were first seen near Chicago April 17, and were abundant April 24. In 1896 they were first seen at Chicago April 11 and again April 12, while in Indiana they were not seen until April 17. In 1895 Chicago reported them April 21, the same date they were observed two hundred miles southeast of there. At Greensburg the earliest and latest dates of first appearance in spring are April 17, 1896, April 23, 1894; Spearsville, April 21, 1895, April 25, 1897; Vigo County, April 24, 1888, April 30, 1889; Bloomington, April 22, 1885, May 6, 1885; Carroll County, April 21, 1885, May 8, 1884; Brookville, April 24, 1889, May 5, 1887; Lafayette, April 24, 1897, May 6, 1892; Francisville, April 19, 1896; Chicago, Ill., April 11, 1896, April 28, 1894; Petersburg, Mich., May 1, 1888, May 5, 1889. They usually leave southern Indiana about May 5 and the northern part of the State a week later, but they may occasionally be found southward until near the middle of the month and northward ten days later than that. They were last reported at Greensburg May 14, 1894; Richmond, May 16, 1897; Terre Haute, May 8,

1889; Petersburg, Mich., May 18, 1888; Chicago, Ill., May 26, 1895. I have only heard its song a few times, from those that were in the woods. It is not loud, but attracts one's attention, as the four notes come from the little singer, who keeps time by the motions of his tail. Their tails are always in motion, and in this they remind one of the Wagtails and Phœbe.

The Palm Warbler is quite an adept at insect catching, often catching them on the wing as a Flycatcher does. "Of eight specimens examined, one had eaten a small hymenoptera; one, five small moths; one, three diptera; two, thirteen beetles, and one five plant lice" (King, Geol. of Wis., I., p. 506). In the fall they begin to return about the middle of September, and linger well into October. They may sometimes remain into November, as they have been noted in the vicinity of Columbus, O., November 7 (1874) (Wheaton), and even in the southern part of the State through December, or possibly, in favorable winters, remain all winter, as it has been taken at Cincinnati, December 24, 1878 (Dury and Freeman). The following early dates give earliest arrival and late dates last departure: Wabash, September 10, 1892; Warren County, September 23, 1897, September 26, 1897; Chicago, Ill., September 13, 1895, October 11, 1896; Lake County, Ind., October 2, 1881; Brookville, September 14, 1897, October 13, 1887.

279. (673). *Dendroica discolor*. (VIEILL.).

Prairie Warbler.

Adult Male.—Above, olive-green, the back spotted with reddish-chestnut; forehead, a line over eye and spot below the eye, yellow; spot in front of eye and stripe under eye, black; wing-bars, yellowish; below, yellow; sides, streaked or spotted with black; lower tail-coverts, buffy. *Adult Female*.—Similar, but duller and less distinctly marked. *Immature*.—Above, more brownish; no wing-bars; few or no chestnut spots on the back or black spots upon the sides.

Length, 4.25-5.00; wing, 2.10-2.30; tail, 1.90-2.10.

RANGE.—Eastern North America, from Central America (?) and West Indies to Wisconsin, Northern Michigan, Mackinac Island and Massachusetts, west to Kansas and Nebraska. Breeds locally throughout most of the range. Winters from Florida south.

Nest, deeply cupped and compact; of soft fibres, grasses; lined with fine grasses or hair; in second-growth, scrub-growth and thickets and in crotch or fork of vine or tree, two to seven feet high. *Eggs*, 4-5; white, creamy-white, greenish-white, dotted or blotched, some all

over and others at large end, where usually wreathed with chestnut and burnt umber; .64 by .47.

The Prairie Warbler is a rare migrant and summer resident. It has not yet been ascertained to breed within the State. Mr. Robert Ridgway has noted it in Knox and Gibson counties, but is uncertain that it breeds. He found it in the former county, April 15, 1881, and met with it frequently afterward that same spring. The late Mr. C. H. Bollman took a specimen near Bloomington, April 26, 1885. Mr. W. O. Wallace took it at Wabash, May 2, 1892. Mr. J. E. Beasley took two near Lebanon, April 29, 1892, and more recently received a female killed June 14, 1896, at English Lake. The latter, and one of the former, are in the State Museum at Indianapolis. It is reported rare throughout Illinois; but one record is given of its occurrence in Wisconsin; and in Ohio it is a rare migrant in the southern and central part, and a summer resident in the northern part of that State. Dr. F. W. Langdon notes it as rare near Cincinnati in May, and Messrs. Dury and Freeman obtained a specimen there May 5, 1879 (Cin. Soc. N. H., I., 1879, p. 172; Ibid, July, 1879). Dr. A. W. Brayton informs me of its occurrence at London, Ky., in June, 1878, and the late Mr. C. W. Bickham reported it from Nelson County.

In Michigan it is found as a rare migrant and summer resident north to Mackinac Island. Its nest and eggs were taken in Ottawa County, May 26, 1879 (Bulletin N. O. C., Vol. IV., p. 186). It is very particular as to its summer home, selecting places suited to its taste, and sometimes breeding in numbers in a very small area. They frequent old clearings, bushy fields and pasture land, and sometimes orchards. There their shyness makes them very inconspicuous objects, save to the person whose ear catches their peculiar song, beginning low and gradually growing louder, resembling the syllables, *wee-wee-chee-chee-chee-chee*. I have no fall records, nor has it ever been found in the Whitewater Valley.

159. GENUS SEIURUS SWAINSON.

*a*¹. Crown orange brown with a black stripe on each side; no superciliary stripe.

***S. aurocapillus* (Linn.). 280**

*a*². Crown color of back; a long superciliary stripe.

*b*¹. Below whitish, lightly streaked; bill over one-half inch long.

***S. motacilla* (Vieill.). 283**

*b*². Below yellowish, heavily streaked; bill not over one-half inch long.

*c*¹. Line over eye buffy; size smaller. ***S. noveboracensis* (Gmel.). 281**

*c*². Line over eye lighter; size larger.

***S. noveboracensis notabilis* (Grinnell). 282**

*280. (674). **Seiurus aurocapillus** (LINN.).**Oven Bird.**

Synonym, GOLDEN-CROWNED THRUSH.



Head of Oven Bird. Natural size.

Adult.—Crown, orange-brown, bordered with two black stripes; no superciliary line; above, bright olive-green; below, pure white, thickly spotted with dusky on breast and sides; a narrow maxillary line of blackish; under wing-coverts, tinged with yellow; a white eye ring; legs, flesh color. Sexes alike. *Young*.—Similar (McIlwraith, p. 374).

Length, 5.40-6.50; wing, 2.75-3.00; tail, 2.00-2.25.

RANGE.—Eastern North America, from Panama north to Labrador, Hudson Bay and Alaska. Breeds from Kansas, Virginia and mountain region of South Carolina northward. Winters from Florida and Mexico south.

Nest, of leaves, grasses, fibre, bark; lined with finer material of the same kind; on ground, in woods, often more or less roofed over. *Eggs*, 3-5, rarely 6; white or creamy-white, sprinkled, usually heaviest, and forming wreath about the larger end with hazel or chestnut or lilac-gray; .80 by .60.

The Oven Bird is so called from the dome-covered, oven-shaped nest it builds. It is known, also, as the Golden-crowned Thrush, from the "old gold" stripe along the center of its crown. It is a common summer resident in the denser woodland of the State. It frequents such land as the Worm-eating Warbler likes—the cool, dark shades of the quiet forest, where amid the thick undergrowth, the fallen trees and broken limbs man nor anything that belongs to him comes to disturb its life. There among the thick carpet of leaves it builds its nest, and just beneath the upper layer the moist, black, humus contains a bountiful supply of choicest food, a reward for very little effort. Throughout the rougher land of southern Indiana, where much forest remains but little disturbed, so far as conditions are concerned, the Oven Bird is very abundant. The rapid destruction of our forests, the burning over of bushy woods and the browsing of live

stock in woodland is all having an effect in lessening the numbers of these birds and other congenial neighbors of theirs who survive as remnants of the forest population of bygone days. They arrive in southern Indiana from April 14 to 30, and in the vicinity of Lake Michigan from April 17 to May 15. The following dates show early and late arrivals at several points: Brookville, April 14, 1883, April 30, 1884; Knox County, April 18, 1894, April 20, 1881; Lafayette, April 29, 1892, 1893 and 1894; Frankfort, April 20, 1896, May 8, 1894; Sedan, April 21, 1896, May 1, 1889; Wabash, April 27, 1892; Chicago, April 17, 1897, May 15, 1886; Petersburg, Mich., April 25, 1897, May 1, 1893.

Who among that select company that is permitted to visit the woods in early spring has not, after a walk over ravine and up hill, along some little, worn path, found his breathing hard and his pulses beating fast from the exertion, and sat down upon a log to rest? All is quiet. From some distance come birds' sounds. The song of the Cardinal, the rattling of the Carolina Wren and the hammering of the Red-bellied Woodpecker; but they come faintly to the ear.

Suddenly, from near at hand, comes the song of a bird that has not been heard since last summer. It is startling in its sudden interjection into the quiet, and its ringing notes arouse the listless auditor from the thoughts of the distant to attention to the near-by singer. John Burroughs has expressed what it seems to say in a way that all who have heard it will recognize. He describes it as "a sort of accelerating chant. Commencing in a very low key, which makes him seem at a very uncertain distance, he grows louder and louder, till his body quakes and his chant runs into a shriek, ringing in my ears with peculiar sharpness. This lay may be represented thus: '*teacher*, TEACHER, TEACHER, TEACHER, TEACHER,' the accent on the first syllable and each word uttered with increased force and shrillness."

The song is that of the Oven Bird. By it he has announced his arrival. During the mating season it is often preceded by from two to four *chips*. There is also another rarer and very different song. When they first arrive it is not difficult to see the bird and note its movements. A little later, when the leaves have darkened the woods, they are hard to recognize unless they sing, and are often difficult to distinguish from the usually abundant Worm-eating Warbler. The high bearing and graceful carriage of the Oven Bird as it walks over the ground or along a log, and the confident attitude it strikes when it begins to sing, strike the eye as forcibly as its song does the ear.

There is another song, called the air song, which is said to be uttered in the evening while it floats in the air above the treetops of the forest.

They are often found mating the first week in May. I found the nest and eggs May 13, 1882, at Brookville, and Prof. Evermann found a nest with a full set of eggs May 28, 1883, in Carroll County. The nest is a curious structure, an interesting object of bird architecture, in which the Cowbird also likes to lay her eggs.

They usually cease singing in June, sometimes extending it until July 23, Mr. E. P. Bicknell tells us. He also says they have a second song period, the extreme dates of which are August 9 and September 5. In July and August, if the season is dry, they leave the drier woods and many of them seem to disappear at that time, though all through the latter month, and occasionally in September, and even early in October, they may be met with singly or in little flocks, making their way southward. The following are the latest records of their occurrence at the places named: Chicago, Ill., October 12, 1895; Sedan, Ind., October 1, 1889; Lafayette, September 27, 1895; Greensburg, September 25, 1897; Trafalgar, September 26, 1897; Bicknell, October 3, 1894; Brookville, October 15, 1889.

While they live largely upon insects, particularly through the spring and summer, they also eat many seeds. "Eight out of ten specimens examined had eaten seeds; one, three caterpillars, and one, three beetles" (King, Geol. of Wis., I., p. 507). They have also been found to eat ants, spiders, small snails and berries.

***281. (675). *Seiurus noveboracensis* (GMEL.).**

Water Thrush.

Synonyms, WATER WAGTAIL, SMALL-BILLED WATER THRUSH.

Adult.—All the upper parts, olive; stripe over eye, yellowish; below, pale sulphur-yellow, brightest on the abdomen; thickly spotted on throat; remaining under parts, except lower belly and lower tail-coverts, streaked with olive-brown.

Length, 5.00-6.00; wing, 3.00-3.10; tail, 2.25-2.40; bill, from nostril, .35-.38.

RANGE.—America, from Venezuela and Guiana over the eastern United States, chiefly east of Mississippi River, to the Arctic Coast. Accidental in Greenland. Breeds from northern Illinois and northern New England northward. Winters from Gulf States south.

Nest, on ground, under bank or the upturned roots of a tree; of leaves, moss and grass, lined with fine grass and rootlets. *Eggs*, 4-6; white, with reddish-brown and lilac markings; .75 by .57.

The Water Thrush is generally a rare migrant; however, some years in the Wabash Valley one form of it is common. It is a rare summer resident northward, where it breeds. About Chicago they are reported as common every year (Tallman, Blackwelder). They are rare in the Whitewater Valley, where only a few specimens have been taken. They are rare in Carroll County (Evermann), Wabash (Ulrey and Wallace), Lake County (Parker), and tolerably common in 1893 at Greencastle (Earlle). Just how far these records refer to the present species is uncertain. The prevailing form in western Indiana seems to be *D. n. notabilis*, though Mr. Ridgway has both forms from Knox County. It is probable that the same is true wherever it is reported as common. Over eastern Indiana, and other places where Small-billed Water Thrushes are rare, the present species is possibly the most numerous, although *notabilis* is also found as far east as the Whitewater Valley. The fact probably is that the species under consideration is rare throughout Indiana. Mr. Nelson has reported it breeding near Chicago; Mr. R. C. Alexander, in Wayne County, Mich., and Hon. R. Wes. McBride, in Dekalb County, Ind.

Prof. F. H. King examined seven of these birds, which had eaten 6 diptera, 6 beetles, 3 orthoptera, 1 dragonfly, 1 hair worm, 14 snails and some pedicels of moss (Geol. of Wis., I., p. 498). This, possibly, should be under the next species.

They pass south in August and September. Chicago, August 19 to September 30, 1896.

This Warbler, for such it is, some winters remains in favorable localities just south of us, and pushes northward into the lower counties of our State very early in April, the advance guard reaching our northern borders from April 20 to May 1. They remain from three to four weeks and then pass north.

They have been taken at Bloomington as early as April 3 (1885), remaining that year until April 21, and the first arrivals in 1886 did not arrive there until April 17. April 3, 1893, it was reported from Greencastle; April 7, 1895, and April 29, 1893, from Lafayette; April 18 to May 3, 1896, from Greensburg; April 28, 1896, from Sedan; May 4, 1893, from Petersburg, Mich. About Chicago it has been reported as early as April 20, 1896, and as late as May 15, 1897. They were common at Bloomington the spring of 1885 (Bollman), April 17, 1886 (Williamson), and the spring of 1888 (Evermann). Mr. Ruthven Deane informs me they were also common the spring of 1888 at English Lake. They have been reported tolerably common at Lafayette the spring of 1895 and 1896, and as not common there the springs of 1893 and 1897. Prof. W. P. Shannon reports them tolerably common at Greensburg the spring of 1896.

282. (675a). *Seiurus noveboracensis notabilis* (RIDGWAY).**Grinnell's Water Thrush.**

Similar to last species, but larger, darker above; stripe over eye and lower parts more whitish.

Length, 5.50-6.00; wing, 3.05-3.25; tail, 2.25-2.50; bill, from nostril, .40-.50.

RANGE.—America, from northern South America, western United States from Indiana to California, and north into British America. Casual on Atlantic coast from northern New Jersey. Winters from Gulf States southward.

This western form of the Small-billed Water Thrush is found throughout Indiana as a migrant and possibly as a rare summer resident in the northern part of the State. It appears to be the common form in the lower Wabash Valley, and in the vicinity of Chicago, Ill. Mr. Ridgway writes me that "Water Thrushes from the Mississippi Valley are very puzzling, but a large majority appear to be referable to *notabilis*." One specimen that I sent him for examination from Brookville, and two collected by Prof. W. S. Blatchley at Terre Haute, he refers to this form. Mr. Ridgway took three adult males May 4 and 6, 1885, at Wheatland, Knox County, numbered, respectively, 104,998, 104,999, 105,000, U. S. Nat. Mus. Register. He says he has also taken it in Wabash and Richland counties, Ill., and there are specimens in the collection of the National Museum from Warsaw, Ill. They have specimens from Wheatland and Vincennes representing both *S. noveboracensis* and *S. n. notabilis*. Mr. J. G. Parker, Jr., says this is the common form of Water Thrush in the vicinity of Chicago. Mr. F. M. Woodruff informs me that Dr. J. A. Allen, to whom he submitted some specimens from the vicinity of Chicago for examination, considers them typical *notabilis*. Mr. W. adds all the specimens I have from northern Indiana are this form.

Migrating birds of this and the last species remain with us in spring after the Large-billed Water Thrushes are breeding. They arrive early in April and pass north late in that month, returning in August and September; Brookville, August 13, 1881; Chicago, September 9, 1885.

283. (676). *Seiurus motacilla* (VIEILL.)*Louisiana Water Thrush.****SYNONYM, LARGE-BILLED WATER THRUSH.**

Adult.—Entire upper parts, olive; white line over eye; below, creamy-white; sides and lower tail-coverts, buff; sides and breast, but not the throat, streaked with black.

Length, 5.75-6.40; wing, 3.20-3.25; tail, 2.20-2.35; bill, from nostril, .40-.45.

RANGE.—Eastern North America, from Panama and Antilles north to Massachusetts, New York, Michigan and Minnesota. Breeds throughout its United States range. Winters from Mexico and West Indies south.

Nest, bulky; of dead leaves, often muddy or partly rotted; lined with grasses, rootlets, weed stems, feathers or hair; near water, in woods, or on ground, under bank, stone or among roots. Eggs, 5, sometimes 4 or 6; white, creamy-white, rarely pinkish-white; markings heaviest at larger end, where they often form a wreath; more or less marked with lilac-gray and speckled and spotted with chestnut, russet, cinnamon-rufous, hazel or vinaceous; .76 by .60.

The Large-billed Water Thrush is a summer resident, common in suitable localities southward, but less common northward. This bird frequents woodlands along streams and about ponds, first appearing late in March or very early in April. It is the first migrant among the Warblers—for both it and the other Water Thrushes are Warblers and only Thrush in name. The visitor to such localities as it seeks is struck by the loud, forcible, metallic *chink*, repeated again and again by a bird which has flown from the banks of a little creek to the horizontal limb of a neighboring elm. Between *chinks* there seem to be just as many beats of its tail, for, as it walks along the limb in a stately manner there is a regular wagging of its tail up and down, and this habit has given it one of its names (Wagtail). But a moment it stays in sight, and then, bowing gracefully, it flies up the creek some distance, and its loud, peculiar song comes ringing through the glen, marking it to the ear as plainly as its tail motions do to the eye. The song, a beautiful, wild, wayward effort, is not always sung from the perch, but frequently is rendered while in flight. I have never known it to sing from the ground. There is another song, which Audubon declared was fully equal to that of the Nightingale. They have first reached Bicknell as early as April 2, 1897, and April 12, 1896; Wabash, April 2, 1892; Bloomington, April 4, 1886; Brookville, April 10, 1895, April 27, 1885; Terre Haute, April 11, 1888; Lafayette, April 20, 1895, May 12, 1894; Sedan, March 30, 1896, April 22, 1894; Petersburg, Mich., April 10, 1892, April 27, 1889; Chicago, April 17, 1886. They are not common as Bluebirds and Jaybirds are common, but in the places they like they are found. Every woodland stream, or spring, or pond, throughout southern Indiana is frequented by them, and the more suitable the conditions, the greater the number. In the northwestern part of the

State, perhaps, including the Kankakee Valley, they are rare. Beyond that stream they are rare.

I have one record from Lake County, May 24, 1879 (Coale). I also have a record of it from the Kankakee, near Kouts, June 27, 1895 (J. G. Parker, Jr.). They are common in the Wabash Valley, north to Parke and Montgomery counties, where I found them building at Shades of Death and Pine Hills, May 19 and 20, 1887; and Lafayette (Test). In Dekalb county it is tolerably common (Mrs. Hine), and at Petersburg, Mich., it is common (Trombley). It breeds in suitable localities wherever it is found. They are sometimes paired when they arrive, and, while I have never taken the nest, I have found, in specimens, eggs ready to be laid, April 21 (1882), and May 7 (1881). Messrs. L. A. and C. D. Test report a nest, with three eggs, taken at Lafayette, May 25, 1893. Mr. Jesse Earle took a nest containing two well incubated eggs at Greencastle, May 7, 1894, and the spring of 1878 Mr. William Brewster found them very common in Knox County, and found three nests, one May 6, containing six eggs; another May 8, containing four fresh eggs; a third, May 12, containing five young birds nearly able to fly.

In July, when the dry summer weather begins, they leave the smaller streams, which are drying up, and seek other localities that are watered. As stream after stream and pond after pond becomes dry, the small number of these birds remaining find food about the stronger streams and ponds fed by springs that have resisted the drouth. By late August or early September most of them have left. I found the latest straggler at Brookville, September 21, 1885, and Mr. E. J. Chansler noted one at Bicknell, Ind., September 24, 1894. They undoubtedly remain much later than that about the sloughs and ponds of the lower Wabash region.

160. GENUS GEOTHYLIPIS CARANIS.

α^1 . Wing much longer than tail; first quill nearly or quite the longest.

Subgenus OPORORNIS Baird.

b^1 . Head with black; under parts yellow. *G. formosa* (Wils.) 284

b^2 . Head without black; crown and throat ashy. *G. agilis* (Wils.). 285

α^2 . Wing not longer than tail; first quill shorter than fourth.

Subgenus GEOTHYLIPIS.

c^1 . Male, forehead and sides of face black; female with head plain.

d^1 . Ashy border behind the black on head; belly and sides buffy whitish.

G. trichas (Linn.). 287

d^2 . White or grayish border behind the black on head; belly yellow.

G. trichas occidentalis Brewst. 288

c^2 . Head and throat ashy, darker on breast which in male is sometimes quite blackish. *G. philadelphia* (Wils.). 286

Subgenus *OPORORNIS* Baird.***284. (677). *Geothlypis formosa* (WILS.).****Kentucky Warbler.**

Head of Kentucky Warbler. Natural size.

Adult Male.—Above, olive-green; top of head, black; ring around eye and stripe from it to the bill, yellow; an irregular black stripe from bill, below and behind the eye, running down on to the neck; below, entirely yellow. *Adult Female*.—Similar, but black crown, marked with gray. *Immature*.—Similar to female, but black patches indistinct or replaced by dusky.

Length, 5.00-5.85; wing, 2.55-2.80; tail, 1.90-2.20; tarsus, .80-.90.

RANGE.—Eastern North America, from Panama and West Indies to Connecticut, southern Michigan and Iowa. Breeds throughout its United States range. Winters from Mexico and Cuba, south.

Nest, on ground, at base of or between forks of a bush in second-growth timber and thickets, along watercourses; material, leaves, lined with pine rootlets. *Eggs*, 4-5, rarely 3 or 6; white or creamy-white, speckled and spotted, chiefly at the larger end, with rufous, vinaceous and lilac-gray; .77 by .57.

The Kentucky Warbler is a summer resident over the southern two-thirds of the State. In Knox County, and presumably from there southward, throughout the lower Wabash Valley, it is "one of the most abundant of the summer residents" (Ridgway, Bull. Nutt. Orn. Club, 1882, p. 20). Mr. Ridgway says, in southern Illinois, "as far north as Wabash, Lawrence and Richland counties, it is even more abundant than the Golden-crowned Thrush, though the two usually inhabit different locations, the latter preferring, as a rule, the dryer upland woods, while the present species is most abundant in the rich woods of the bottom lands" (Birds of Ill., I., p. 166). In the White-water Valley, where there are no bottom woods to speak of, they are found in the same dark, damp woods, and, in addition to the present species, is found along spring banks, wet places and streams in the deeper woods. They are common up the Wabash Valley to Terre

Haute (Evermann and Slonaker); Parke and Montgomery counties, in the former of which I found a nest, containing one fresh egg, on the ground, on the side of a ravine at Shades of Death; Lafayette (L. A. and C. D. Test). They are rather common at Bloomington (Williamson, Blatchley); Greencastle (Earle, Jenkins); Morgan County (Hadley); Moore's Hill (Hubbard), and Spearsville (Barnett). I have found them rather common to the southern boundary of Fayette County, in the Whitewater Valley. They have been reported from Dunreith (Pleas), and as rare at Lebanon (Beasley). Two specimens were taken three miles southwest of Indianapolis, in May, 1878 (Dr. A. W. Brayton). They are quite common in the vicinity of Cincinnati (Dury and Freeman, Journ. Cin. Soc. Nat. Hist., 1879). The farthest north its range has been extended in this State is Gibson Station, where, Mr. C. E. Aiken informs me, several specimens were taken in May, 1871. It has, however, been taken in Michigan (Cook, B. of M., p. 136). They arrive from April 17 to May 16. In some localities most of them disappear by the middle of July, while at other places they are reported common until the last of August, and occasionally remain until October.

Extreme dates of their arrival are: At Bloomington, April 17, 1886, May 7, 1892; Knox County, April 20, 1881; Brookville, April 20, 1896, May 16, 1884; Terre Haute, April 28, 1889, May 5, 1888; Spearsville, April 29, 1895; Moore's Hill, May 1, 1893; Lebanon, April 26, 1894; Lafayette, May 6, 1893, May 8, 1892. I have observed them mating at Brookville, May 16, 1884. They were found breeding near Bloomington, May 6, 1886 (Evermann), where young were noted just out of the nest, June 4, 1886 (Blatchley). August 2, 1897, I found an old bird feeding a young one in a thicket along a quiet wooded stream near Brookville.

As it occurs, walking upon the smoother ground, it reminds one much of the Golden-crowned Thrush in its actions. It carries its body evenly balanced, apparently, and the equilibrium is only maintained with much difficulty by using its tail as a balance, causing that appendage to bob up and down. Hopping about a steep, springy bank, it reminds one of the Worm-eating Warbler, as it climbs over roots, sticks and logs, now disappearing from view in a hole beneath the roots, then behind a log, here stopping to peck at an insect, and there turning over the leaves.

Where a little stream trickled out of the glacial till, it finds much food that attracts it. Occasionally, even, it would seize an insect in the air, after the manner of a Redstart. As it moves about it occasionally utters a *tchip*, and more rarely sings its song, which at other

times it renders persistently. This song, Mr. Ridgway says, "recalls that of the Cardinal, but is much weaker." Mr. Chapman says: "It is a loud, clearly whistled performance of five, six or seven notes—*tur-dle, tur-dle, tur-dle*—resembling in tone some of the calls of the Carolina Wren" (B. E. N. A., p. 369). At Lafayette, they appeared common until August 29, 1894, when it was last seen (L. A. and C. D. Test). Mr. J. E. Beasley reports six from Lebanon, October 11, 1894.

285. (678) *Geothlypis agilis* (WILS.).

Connecticut Warbler.

Adult Male.—"Olive-green, becoming ashy on the head; below, from the breast, yellow, olive-shaded on the sides; chin, throat and breast, brownish-ash; a whitish ring round the eye; wings and tail, unmarked, glossed with olive; under mandibles and feet, pale; no decided markings anywhere. In *Spring Birds*, the ash of the head, throat and breast is quite pure, and then the resemblance to *Geothlypis philadelphia* is quite close" (Coues).

Length, 5.20-6.00; wing, 2.65-3.00; tail, 1.90-2.20; tarsus, .75-.90.

RANGE.—America, from northern South America through eastern United States to Ontario and Manitoba. Breeds north of United States. Winters south of United States.

Nest, in a depression in the ground, of fine grass. *Eggs*, 4; white, with a few spots of lilac, purple, brown and black about the larger end. (Thompson).

The Connecticut Warbler is, in general, a very rare migrant in Indiana. I have met with it three years out of nineteen at Brookville. May 22-25, 1882, I found it rather common there, frequenting brush piles, tangled fencerows, the edges of thickets and of woods, where their habits seemed to be much like those of the Maryland Yellowthroat, except they are much more shy. When they are found in a rick of brush, they move along within the brush pile after the manner of a Wren, and it is impossible to dislodge them or even to obtain more than a quick glimpse of them at short range, until the end of the windrow is reached, and they fly close to the ground in the nearest pile or thicket. Along the edge of a thicket or wood they sometimes expose themselves in the weeds and grass, but upon the approach of anything strange they dart into the tangle of vines, briars and shrubbery, from which it is impossible to flush them.

Mr. Robert Ridgway found them not common in Knox County, about the middle of May, 1881. They frequented the borders of swamps, and when surprised, disappeared among the button bushes

(Bull. Nutt. Orn. Club, Vol. VII., June, 1882). Mr. I. M. Woodruff observed several specimens in the bushes along the shore of Wolf Lake, near Sheffield, Ind., in May, 1889, where he obtained a specimen, May 13, 1894. Mr. Ruthven Deane informs me they were quite common at English Lake, May 4, 1891. That is the earliest date at which they have been noted in the State. Although Mr. Nelson reported it a rather common migrant in the vicinity of Chicago, more recent observers have not found it so. They usually arrive after the middle of May, and pass northward toward their breeding grounds toward the close of the month. They were noted in Carroll County, May 21, 1883, and 1885, and at Terre Haute, May 17, 1890 (Evermann); May 12, 1888 (Blatchley); Bloomington, May 18, 1885 (Bollman). In Lake County, a specimen was found among the bodies of many kinds of small birds that had perished in a storm on Lake Michigan, and been cast up by the waves on the shore, May 24, 1891 (Coale). In the fall, they reach northern Indiana early in September, and sometimes remain until the latter part of the month. They were found in Lake County, September 5, 1880, and September 25, 1875 (Coale).

Mr. W. O. Wallace obtained one specimen in thick woods near Wabash, September 13, 1892. Mr. Ernest E. Thompson found its nest in a log near Carberry, Manitoba, June 21, 1883. I have given a description of it above. The ordinary song suggests the syllables, *bee-cher-bee-cher-bee-cher-bee-cher-bee-cher*. "It is somewhat like the song of the Oven-bird, but different, in being the same pitch throughout instead of beginning in a whisper and increasing the emphasis and strength with each pair of notes to the last." It also has another song, nearly resembling the syllables, *fru-chapple, fru-chapple, fru-chapple, whait*, which is uttered in a loud, ringing voice (Proc. U. S. N. M., Vol. XIII., 1890, pp. 621, 622).

When with us I have never heard it singing.

Subgenus *GEOTHLYPIS* Cabanis.

286. (679). *Geothlypis philadelphia* (WILS.).

Mourning Warbler.

Synonym, *PHILADELPHIA* WARBLER.

Adult Male.—Above, plain olive-green; the head, and sides of the neck, bluish-gray; a black spot in front of eye; eyelids, blackish; wings, and tail, unmarked; below, throat and breast, black, the feathers more or less bordered with ashy; other under parts, yellow. *Adult Female*.—Similar, with head smoky-gray, more or less tinged with olive; the throat, pale yellowish-gray; eyelids, and an indistinct mark behind the eye, yellowish.

Length, 4.90-5.75; wing, 2.15-2.55; tail, 1.80-2.25.

RANGE.—America, from Colombia over eastern United States to British Provinces; casually to Greenland. Breeds from Nebraska, Ontario and New York, north. Winters from Mexico, southward.

Nest, in outskirts of woods or thickets, near ground; of weedstalks, leaves and bark, lined with fine black rootlets or hair. *Eggs*, 3-4; creamy-white, blotched and spotted with reddish-brown and lilac, often chiefly arranged in more or less distinct wreath around larger end; .71 by .56.

The Mourning Warbler is a rare migrant. Occasionally there will come a few years when it is more common in some locality. From the Whitewater Valley there is but a single record. They arrive some years by May 6, and occasionally may be found until June 1. In the latter part of May they are sometimes found associating with *Geothlypis agilis*. Mr. Robert Ridgway says, at Wheatland, they "became suddenly very common, May 6, 1881" (Bull. Nutt. Orn. Club, 1882, p. 20). Mr. F. M. Woodruff informs me that he saw several in May, 1889, in the bushes along the shore of Wolf Lake, near Sheffield, Ind. They were in company with *G. agilis*. He also collected two in Cook County, Ill., on the ridge between Hyde and Wolf lakes, near the Indiana line, May 29, 1894. It seems to have been rather common at Bloomington, the spring of 1885. The late Mr. C. H. Bollman reported it May 16, 17 and 27. Mr. W. O. Wallace says they were rather common at Wabash, in open thickets, in the spring of 1892.

Mr. H. K. Coale informed me that Mr. Geo. F. Clingman shot a specimen in Lake County, June 1, 1879. This specimen was sent to the British Museum, where Prof. R. B. Sharpe identified it as *Geothlypis macgillivrayi* (Aud.) (Cat. Birds, Brit. Mus., Vol. X., p. 365). Mr. Coale and Mr. Ridgway are both of the opinion that the specimen is undoubtedly *G. philadelphia*. From all southeastern Indiana, including the Whitewater Valley, there is but one record of its occurrence—Brookville, May 7, 1881. It was taken at Terre Haute, May 10, 1887, and May 22, 1890; and in Carroll County, May 21, 1885 (Evermann); at Waterloo, May 8, 1890 (H. W. McBride); Petersburg, Mich., May 17, 1888 (Trombley); Manchester, Mich., May 20, 1893 (L. W. Watkins). It has been reported from Allen County (Stockbridge). It may possibly be found to breed within this State, though I have no account of its having done so. Mr. Ridgway has found it along the borders of Fox Prairie, Richland County, Ill., early in June, 1871. They may have been late migrants, however (Orn. of Ill., I., p. 170). Mr. Oliver Davie says: "It has been found nesting

in Illinois, south of latitude 39 degrees" (N. and E. of N. A. B., 1889, p. 382). Mr. Walter Faxon says its song, as most often heard, "resembles the syllables *thur-ree, thur-ree, thur-ree*. (Sometimes the repetition was four times instead of three)." To this was sometimes added a refrain; at others, the song was different. They also sing an aerial song. Their habits, in some respects, are similar to those of the Maryland Yellow-throat, but they are not so quick-motioned, and are to be found at times more up in the bushes or even the low limbs of trees. They pass south in August and September. Prof. W. W. Cooke says: "It has been found nesting in Illinois even south of latitude 39 degrees" (Bull. No. 2, Div. of Economic Ornithology, U. S. Dept. Agr., p. 258).

***287. (681). *Geothlypis trichas* (LINN.).**

Maryland Yellow-throat.



Head of Maryland Yellow-throat, male. Natural size.

Adult Male.—Above, plain olive-green; a black band, bordered behind with grayish-white, from the ear coverts along the side of neck, through the eye and across the forehead; no markings on wings or tail; throat and breast, rich gamboge-yellow; belly, sides and flanks, dull yellowish-white. *Adult Female*.—No black about head; below, less yellow; sides, somewhat brownish. *Immature Male*.—With black markings more or less restricted; young birds, resembling the females, but browner above.

Length, 4.40-4.65; wing, 1.90-2.20; tail, 1.85-2.20; bill, .38-.42; tarsus, .71-.80.

RANGE.—Eastern North America, from Panama, eastern Mexico and West Indies to Labrador and Ontario. Breeds from Georgia, north. Winters from South America and Gulf States, south.

Nest, in thicket, often near water, swamp, on or near ground, in grass, sedge, reeds or bush; of leaves or grass, lined with grass and horsehair. *Eggs*, 4-5, rarely 3 or 6; white or creamy-white, variously speckled, spotted and sometimes lined with russet, burnt umber or

chestnut, purplish, lilac-gray or vinaceous and black, principally confined to larger end; .77 by .58, .61 by .50, .63 by .48; average, .67 by .52.

Common summer resident throughout the State, where it frequents the tall grasses, sedges and shrubbery about the swamps and damp places and along the valleys of streams. The first migrants arrive from April 15 to 27, southward, and from April 19 to May 17, northward. The males come first, and, while most of them seek their favorite tangles and low thickets, some wander away to the hillsides and uplands. They have been recorded as first arriving at Bicknell, April 17, 1896, 1897; Greencastle, April 17, 1896, April 28, 1894; Frankfort, April 17, 1896, May 16, 1895; Wabash, April 15, 1893; Brookville, April 18, 1883, 1896, May 5, 1882; Greensburg, April 18, 1896, April 28, 1894; Sedan, April 19, 1889, April 30, 1887, 1897; Petersburg, Mich., April 27, 1888, May 5, 1889, 1897; Chicago, Ill., April 27, 1896, May 17, 1884. Their characteristic voice betokens their coming. It is distinct and penetrating and carries to quite a distance. The song reminds one of one of the well known utterances of the Carolina Wren (*T. ludovicianus*), but the difference is easily recognized, and, with care, one can not be deceived. It may be said that all songs are not alike. There is quite a difference in them, when close to the singer, but when one is some distance away, a note may be missed, and the song would be recorded on the memory without it. The common interpretation of the song of the Maryland Yellow-throat is *wichity, wichity, wichity*. I find many of them, sometimes all in a locality, saying *wit-ti-chee, wit-ti-chee, wit-ti-chee*. It sounds plainly at a distance of twenty feet. A call that came to me from three hundred feet away was plainly *wi-chee, wi-chee, wi-chee, wi-chee*, uttered in a fine, clear voice. After June their voices are not so commonly heard. Though they drop out of the sounds of the neighborhood, they are not entirely gone, for one is heard now and then, perhaps as long as they remain.

I have found them paired by May (1885) and often with full sets of eggs by the latter part of that month. Prof. B. W. Evermann found a nest, with five fresh eggs, in Carroll County, May 22, 1883, and June 12, 1880, found young able to fly. Sometimes they rear two broods. In August they begin to leave and often are gone by the middle of September. Other years they remain until October. The latest dates from the following places are: Sedan, September 16, 1894; Brookville, September 10, 1885; Bicknell, October 5, 1896; Warren County, September 25, 1897; Greensburg, October 10, 1896.

Mr. E. R. Quick has in his collection a three-story nest of this bird.

taken near Brookville, Ind. Two additional nests were built upon the original structure, burying beneath each the egg of a Cowbird (*Molothrus ater*). Thus it outwitted the detestable parasite, and in the third nest deposited her complement of eggs. Similar nests have been found elsewhere, showing that this was not an individual peculiarity, but others of its kind had experimented along the same line.

Prof. F. H. King examined eleven specimens, which he found had eaten 22 case-bearing caterpillars (*Coleophora* ?), 5 other larvæ (2 of them caterpillars), 6 small dragon flies, 3 moths, 3 dipterous insects, 3 very small hymenopterous insects, 3 beetles (among them a squash beetle), 3 spiders, 2 small grasshoppers, 1 leafhopper, 2 hemipterous insects, and 2 insect eggs (Geol. of Wis., I., p. 508). As a result of such examination as has been made, it seems that the prevailing Yellow-throat in Indiana is the Maryland—this bird. Mr. Robert Ridgway informs me that the Maryland Yellow-throats in the Smithsonian collection from Indiana (Wheatland and Vincennes) are either true *G. trichas*, or else that form approaching *G. t. occidentalis*. More recently I have sent him a series of Yellow-throats, containing specimens from Indiana, northern Illinois, Jamaica and the Valley of Mexico. All of these, after comparison, he decides to refer to *G. trichas*. He adds: "The Mississippi Valley birds and those from Mexico (valley) are in reality intermediate between *trichas* and *occidentalis*."

***288. (681a). *Geothlypis trichas occidentalis* BREWSTER.**

Western Yellow-throat.

Similar to *G. trichas*, but averaging larger; the lower parts, yellow and not part whitish.

Length, 4.75-5.85; wing, 2.10-2.40; tail, 2.15-2.40; bill, .40-.45; tarsus, .75-.83.

RANGE.—Western North America, from Central America and western Mexico over western United States to Manitoba and British Columbia, east to Illinois and Indiana.

Nest and Eggs as in last species.

The Western Yellow-throat is a summer resident, like the last, wherever found. I am informed by Mr. Eliot Blackwelder and Mr. J. G. Parker, Jr., that this is the prevailing form in Cook County, Ill., and the last named gentleman says it is the same in Lake County, Ind., where he has taken specimens at Liverpool. Mr. Parker says it is abundant in low ground bordering our marshes and along the banks of our creeks and rivers. Arrives May 1 to 15. It is possible that the form inhabiting the prairie districts may be found to approach more closely to this bird.

161. GENUS *ICTERIA* VIRILLLOT.***289. (683). *Icteria virens* (LINN.).****Yellow-breasted Chat.**

Head of Yellow-breasted Chat. Natural size.

Adult.—Size, large; above, olive-green; black spot in front of eye; ring around eye and stripe to nostril, white; below, throat, breast and edge of wing, gamboge-yellow; white stripe on sides of throat; belly and under tail coverts, white. •*Adult Female*.—Similar, but colors less bright; grayer markings, less distinct.

Length, 6.75-7.50; wing, 2.90-3.35; tail, 2.90-3.35.

RANGE.—Eastern North America, from Costa Rica over eastern United States to Massachusetts, southern Ontario and southern Minnesota, west to Plains. Breeds from Gulf States, north. Winters from Mexico, south.

Nest, in thickets, second or scrub-growth, in solitude; on brier bush or sapling, 2 to 5 feet up; of leaves, grapevine bark or grass; long and bulky. *Eggs*, 63 sets—9 of 3, 53 of 4, 1 of 5; white, often glossy, spotted and blotched in different patterns, sometimes wreath around one end, with different shades of red and brown, and often lilac; .92 by .63.

The Yellow-breasted Chat is a common and well known summer resident in the southern half of the State, and locally even farther north. In the northern half it is usually not common, becoming less numerous as one approaches the northern boundary, where it is, most places, usually rare. It breeds throughout its range in this State. They are common at Richmond (Hadley), Anderson (Smith), and Lafayette (Test Bros.); tolerably common at Frankfort (Ghere) and Laporte (Barber); not common at Wabash (Ulrey and Wallace); rather rare in Carroll County (Evermann); rare in Allen County (Stockbridge), Dekalb County (Hon. R. W. McBride), Starke County (Deane), Elkhart County (H. W. McBride).

Prior to 1893 it was almost unknown in the northwestern portion of the State, and the same may be said along the northern State line in

both Indiana and Michigan. Hitherto there had been but one record from Lake County, but Prof. E. L. Moseley saw one at East Chicago, Ind., July 2, 1893. July 13, 1894, Mr. F. M. Woodruff took a nest at Grand Crossing, Cook County, Ill., and on the 17th saw two birds at Sheffield, Ind. He also informs me that Mr. Geo. K. Cherrie saw two and took one at Hyde Lake, June 16, 1896, probably in Indiana. There seems to have been a considerable extension of their numbers northward in 1894. It was taken at Ann Arbor, Mich., the spring of 1894 (L. W. Watkins); at Petersburg, Mich., two were taken May 3, and two May 17, 1894; two nests were also found. It had not been taken before since 1877 (J. Trombley). One was seen at Cedar Point, near Sandusky, O., June 23, 1894, and another at Huron River, twelve miles south of Sandusky, July 10, 1894. They arrive in southern Indiana from April 23 to May 4, and those found farther north reach there, generally, after the latter date. The first arrivals were noted at Bicknell, April 23, 1897, April 27, 1894; Brookville, April 24, 1897, May 4, 1882; Moore's Hill, April 29, 1893; Spearsville, April 27, 1895, April 29, 1894; Greensburg, April 25, 1896, April 30, 1895; Greencastle, May 2, 1894, 1895, May 9, 1896; Wabash, May 10, 1892.

Every one who is acquainted with brier patches, thickets and bushy clearings, knows this bird. If they do not know its name, they know it as the bird which fills the thicket with such sounds as no other bird ever dreamed of. It is more often heard than seen. Were it not that occasionally its yellow breast comes into view, we should think it but a voice among the bushes. They are great ventriloquists. Often a person unacquainted with their habit will look long in the direction from which the sound seems to come and not see the author, who is elsewhere. They have quite a variety of notes, which, with their strange antics, render them the most interesting summer birds among the bushes. At mating time they devote much time to aerial evolutions, which are always interesting because of their oddity, but at times become exceedingly ludicrous. While performing these various evolutions they give voice to a multitude of strange sounds, that seem to come from here, there and everywhere, except the throat of the odd and awkward bird descending towards the clump of bushes near by. The late Dr. J. M. Wheaton gives the following excellent expression of his feelings regarding this bird:

"When migrating, no bird is more shy and retiring than the Chat. They skulk along silently in thickets, along the banks of streams, or on the edges of upland woods. But no sooner has pairing been effected than their whole nature seems changed, and the silent bird becomes the noisiest of the wood. His shyness gives way to an audacity that is

surprising. If he discovers the approach of a human being, even at a considerable distance, he prepares to resent the intrusion; and, giving three short, loud whistles, very low in tone, as a warning, he advances toward him, all the while careful that he should be heard and not seen. Then follows a medley of sputtering, cackling, whispering and scolding notes, frequently interspersed with loud whistles, and continued as the bird runs, hops or flies in the deepest thicket, with a pertinacity which knows no fatigue. He tells you that your gun won't shoot, that it is a flint-lock, that your ramrod is broken, that you shot it at a buzzard, that you haven't got a gun; that you are a bald-headed cripple; that there is a horrid suicide in the bushes, and a big snake and a nasty skunk; that your baby is crying, your house is afire and the bridge broken down; that you have missed the road to the reform farm, and that the poor house is over the creek, and he calls the dogs; says that you have gone to seed; go west and grow up with the country; that you are taking up too much of his valuable time, that you must excuse him for a moment.

"During all this time he remains invisible, or, at most, his black eye and mask, or golden breast, appear for a moment as he peers at you from the tangled branches of the brambles, or flashes from branch to branch, dancing an accompaniment to his fantastic notes. At the last he suddenly appears on the top of a bush, not ten feet from you, makes a profound bow with a derisive whisk of his long tail, exposes his immaculate white crissum and dives again into the deepest thickets. You take a long breath and wipe your face, and he returns to the assault from the rear. Should you move on, he follows, and if you approach, he retires, and, keeping at a respectful distance, he laughs defiance, shouts mockery and tantalizing sarcasm. He is a fearful scold, and it is no wonder the inside of his mouth is black. But this is when he knows that he has the advantage. Sometimes he may be surprised, as he sings in the upper branches of a tree. He then sits motionless, continuing his song as if unaware of any intrusion upon his privacy, and so resonant and varying are his notes that they confuse the ear as to the spot from which they come, while his yellow breast so completely harmonizes with the green leaves and sunlight that he is with difficulty discovered. It is to his rapid and sonorous notes, quick motions or perfect quiet, with harmonious surroundings, that he owes the reputation for ventriloquism which he has obtained; and it may be said of his reputation for mimicry that he has no need to borrow notes from any other bird, and does not knowingly do so. Before the breeding season is over it becomes as silent as during the spring migration, and leaves for the south as stealthily as it came."

They sing until the young leave the nest, usually from the latter part of June until the middle of July; and then, for a time, the family keeps together.

After the singing is over, the only note heard is the single note, *chat*, from which the Yellow-breasted bird takes its name.

I have found them mating April 27, 1885, and found a nest, with eggs, May 25, 1882. June 11, 1892, Messrs. L. A. and C. D. Test found two nests near Lafayette. Each contained four eggs, and in addition had two eggs of the Cowbird. They usually leave in September—Brookville, September 7, 1886; Bicknell, September 27, 1894—but occasionally remain much later. I shot one, December 1, 1881, when it was feeding upon pokeberries, from which its plumage was stained.

Two excellent accounts of the Chat are given, one by Dr. Coues—Birds of Colorado Valley—the other by John Burroughs, in "Wake Robin."

162. GENUS SYLVANIA NUTTALL.

*a*¹. Tail feathers blotched with white. *S. mitrata* (Gmel.). 290

*a*². Tail feathers dusky, not blotched with white.

*b*¹. Above plain olive green; male with blue black patch on crown.

S. pusilla (Wils.). 291

*b*². Above plumbeous gray; crissum white; male, crown, forehead and sides of throat spotted black. *S. canadensis* (Linn.). 292

*290. (684). *Sylvania mitrata* (Gmel.).

Hooded Warbler.

Adult Male.—Head, neck and throat, deep black; a gamboge-yellow band across the forehead and along the side of head, including the eye and the ear coverts; other upper parts, olive-green; other lower parts, bright yellow; three or four pairs of outer tail feathers, with white markings; wings, unmarked. *Adult Female*.—Similar, but usually with less black on head. *Immature Male*.—Varying from the decided black markings of adult male to almost no black; the yellow, however, conspicuous. *Immature Female*.—Lacking black markings.

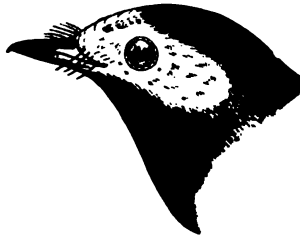
Note.—It seems evident that it requires three years for this Warbler to attain perfect plumage; therefore, specimens will be found at different seasons in different stages of color development.

Length, 5.00-5.70; wing, 2.50-2.75; tail, 2.20-2.40.

RANGE.—Eastern North America, from Panama and West Indies to Massachusetts, southern Ontario, southern Michigan and southern Wisconsin, west to Kansas. Breeds from Texas and North Carolina, north. Winters south of United States.

Nest, in woods, low bush or tree, three feet up; in wet swamp, one foot up; of bark, moss, vegetable fibre, leaves and grasses, lined with the finer material. *Eggs*, 4, rarely 3 or 5; white or creamy-white, often quite glossy, marked with specks and spots of light to dark reddish-brown and lilac. The markings principally at larger end, where they sometimes form wreaths; .70 by .51.

The Hooded Warbler is generally a rare summer resident. However, in the lower Wabash Valley it is said, in some places, to be common. On the contrary, in the northern part of the State, it is very rare. Everywhere it is more numerous during the migrations. They arrive, in spring, from April 16 to May 16. They were first noted at Greensburg, April 16, 1896; at Bloomington, April 20, 1885, May 8,



Head of Hooded Warbler. Natural Size.

1886; Knox County, April 25, 1881; Spearsville, April 30, 1894; Brookville, April 30, 1881, May 16, 1884; Carroll County, May 5, 1885; Sedan, May 15, 1889; Chicago, Ill., April 28, 1884. They frequent woods in which there is a dense undergrowth, being found among the bushes and lower branches of the trees. There they are quite active, especially when mating begins. The male goes singing through the bushes and flitting from branch to branch of the overshadowing trees, singing its song, and all the while opening and closing its tail, exposing the white of the feathers. An insect comes within easy range, the song stops suddenly, the tail remains closed, the insect is caught, and then the song and the peculiar motions of the tail are resumed. The song, as given by Mr. Langille, is "*che-reek, che-reek, che-reek, chi-di-ee*;" the first three notes with a loud fell-like ring, and the rest in very much accelerated time and with the falling inflection."

It also has another less common song and a peculiar *chip*. Dr. Haymond reported it as a summer resident in Franklin County (Ind. Geol. Rept., 1869, p. 217), but it must be rarely such, for I have not found it at that season. Dr. F. W. Langdon has noted it as a summer resident in the vicinity of Cincinnati (Journ. Cin. Soc. Nat. Hist., July,

1880, p. 123). Mr. Robert Ridgway says, in Knox County, it is "rather common in deep woods, but much less so than in the vicinity of the cypress swamp farther south" (Bull. Nutt. Orn. Club, Vol. VII., 1882, p. 20). He writes me they breed in Knox and Gibson counties. In another place he says: "In all rich, damp woods, both in Illinois and Indiana, I have found the beautiful Hooded Warbler a more or less common species. In the woods of Knox and Gibson counties, Indiana, immediately opposite Mt. Carmel, it is particularly abundant, so much so, in fact, as to be one of the most characteristic species" (Ill. Orn., I., pp. 174, 175). Prof. B. W. Evermann reports it not common in Vigo County. On the contrary, they were quite common in the valley of Sugar Creek, in Parke and Montgomery counties, May 19 and 20, 1887. At Bloomington, Mr. G. G. Williamson found a nest of this species in a bush, containing six young. May 26, 1886. It seems to occur there regularly. It is reported from Decatur (Shannon) and Brown (Barnett) counties. Mr. N. H. Coale obtained one at Davis Station, Starke County, May 31, 1885, but previously, May 24, 1879, had recorded it from still farther north. On the latter date he found the shore of Lake Michigan, in Lake County, lined with the bodies of many small birds that had perished in the lake during the recent storm. The record of its destruction was before him, and among the bodies of the victims he found a Hooded Warbler. In Dekalb County, Mrs. Jane L. Hine has noted it a few times, twice in October. The last time was October 5, 1893. They begin to leave in August, and through September and early October they are vagrants, changing their homes as whim or necessity dictates, but all the while working back towards the south. Dr. Langdon found it at Cincinnati, May 4, and Messrs. Dury and Freeman, May 30, 1879. It was taken at Wabash, September 13, 1893; at Bicknell, September 16, 1894; at Lebanon, four were seen, October 20, 1894, and it was observed at Brookville, October 20, 1884.

Their habit of taking their insect food upon the wing has been noted by all observers, though they doubtless also take other insects.

291. (685). *Sylvania pusilla* (Wils.).**Wilson's Warbler.**

Synonyms, GREEN BLACK-CAPPED FLY-CATCHING WARBLER, BLACK-CAPPED YELLOW WARBLER.

Adult Male.—Crown, glossy blue-black; stripe over eye and across forehead, yellow; other upper parts, bright olive-green; below, clear yellow; wings and tail, with no white markings. *Adult Female*.—Similar to male, but crown patch usually less conspicuous, sometimes wanting. *Immature*.—With no black on head.

Length, 4.25-5.10; wing, 2.15-2.35; tail, 2.05-2.25.

RANGE.—North America, east of Pacific coast, from Panama to Labrador, Alaska and Siberia. Breeds from Nova Scotia, Ontario, Minnesota and along Rocky Mountains from Colorado, north. Winters from eastern Mexico, south.

Nest, in damp woods, on ground; of leaves and grass, lined with fine grass or hair. *Eggs*, 4-5; white or creamy-white, speckled with reddish-brown, pale lavender or lilac-gray.

Wilson's Warbler occurs throughout the State as a migrant. Usually, in the spring, they are rather rare, but are more common in the fall. This reverses the migratory period with the Connecticut Warbler, which is almost unknown in fall west of the Alleghanies, but is common on the Atlantic coast. Like that species, Wilson's Warbler arrives late in spring, usually after May 10, and remains until the close of that month. The earliest Indiana record is, Bloomington, May 8, 1886. Other dates where it was first observed in spring are: Greensburg, May 13, 1894; Richmond, May 16, 1897; Terre Haute, May 10, 1890; Carroll County, May 18, 1885; Lafayette, May 12, 1892, May 13, 1893; Sedan, May 10, 1894; Lake County, May 18, 1895; Chicago, Ill., May 6, 1886, last seen May 30, 1894. About the lower end of Lake Michigan they are sometimes not uncommon (Parker). They were tolerably common at Greensburg in May, 1894, being last noted May 29 (Shannon); at Greencastle, in 1893, where eight were noted May 13 (Earlle); at Sedan, May 20, 21 and 22, 1890 (Mrs. Hine). They have been also noted from Wabash, the spring of 1892, and there is a specimen in the State Museum at Indianapolis, from Boone County. Prof. F. H. King notes that one was killed in Wisconsin by a cold wave in May, 1882. I found one in May, 1887, with a number of other lifeless birds on the shore of Lake Michigan, where they had been cast up by the waves after losing their lives in a storm.

It frequents the undergrowth of woodlands and the wooded borders of streams, in spring, but in fall it is often found frequenting the same ground with Tennessee Warblers, weedy woods-pastures and more open woodland, and even bushy fencerows. They are quite active, taking much of their insect food upon the wing. Nuttall says their song sounds like 'tsh-'tsh-'tsh-'tshea.

292. (686). *Sylvania canadensis* (LINN.).

Canadian Warbler.

Synonym, CANADIAN FLY-CATCHING WARBLER.



Head of Canadian Warbler. Natural size.

Adult Male.—Above, gray; wings, brownish; forehead and crown, spotted with black; stripe from bill to eye and ring around eye, yellow; below, yellow; lower tail coverts, white; a black streak on each side of throat, united by a row of black spots across the breast; wings and tail, not marked with white. *Adult Female*.—Similar, but the markings less distinct. *Young*.—Similar to female, but black marks wanting; breast, streaked with dusky.

Length, 5.00-5.75; wing, 2.50-2.65; tail, 2.20-2.40.

RANGE.—America, from Ecuador north over the eastern United States to Labrador and Manitoba. Breeds from Massachusetts, Pennsylvania, Ontario and Minnesota, north. Winters from Mexico, south.

Nest, in woods or low growth, on the ground, in a depression or among roots; of leaves, dry weed stalks, roots and hair. *Eggs*, 4-5; white, finely marked with dots and small spots of brown, purple and reddish, in varying shades; rufous and rufous-brown, heaviest at larger end; .68 by .51.

The Canadian Warbler is a tolerably common migrant, varying in numbers with the years. It is usually much more common, sometimes even abundant, in fall. It rarely arrives before May 1, and often remains until the last of that month. Like the other two species of this genus, which are less common than this, they frequent low situa-

tions, bushes and underbrush, seldom going higher than the branches of short-bodied trees. This species frequents the edges of woodlands and thickets along streams and on waste land. There they may be found industriously catching insects, taking most of them on the wing. Its song may be heard about its haunts morning and evening. It is a characteristic voice that instantly draws one's attention to it. Often it has called me away into some little thicket in a woods pasture or among the low, drooping limbs of some unpromising looking beech trees in the edge of heavy timber. Those which seem the most unpromising places to men are often attractive to birds. Several times, as I can recall, the best take of the day or the season was found in some uninviting spot, to which I was drawn merely incidentally.

Mr. Earnest E. Thompson notes its loud and striking song as *rup-it-che, rup-it-che, rup-it-chitt-it-litt.*" The earliest spring record is from Knox County, where Mr. Robert Ridgway took it, April 18, 1881. It has been first noted in spring at Bloomington, April 27, 1886; Brookville, May 2, 1881, May 16, 1884; Richmond, May 16, 1897; Lafayette, May 16, 1897; Carroll County, May 12, 1885; Wabash, May 10, 1892; Starke County, May 11, 1884; Lake County, May 9, 1877, May 16, 1880; Chicago, Ill., May 1, 1886, May 18, 1896; Petersburg, Mich., May 11, 1888, May 16, 1893. May 21, 1892, one was caught in the office of Purdue University, at Lafayette (L. A. and C. D. Test). They have remained at Greencastle until May 26, 1895; at Spearsville, May 24, 1894; Lafayette, May 25, 1893; Carroll County, May 24, 1883; Chicago, Ill., May 30, 1894; Petersburg, Mich., June 1, 1893. When they return in the fall they are songless. They arrive some years late in August and most of them pass through early in September, though one occasionally lingers into the beginning of October. They were tolerably common about Chicago, August 26 to September 5, 1895 (Blackwelder), and were common near Cincinnati the last of August and the first of September, 1879 (Dury and Freeman). The last fall note at Sedan is September 7, 1889; at Lafayette, September 4, 1894; Warren County, September 12 and 15, 1897; Lake County, September 18, 1881. Prof. E. L. Moseley informs me he obtained a specimen at Sandusky, O., October 2, 1896.

It has not been found in this State later in summer than the dates given above. Prof. W. W. Cooke, in his report on Birds of Michigan in the Mississippi Valley for 1884 and 1885, says it has been known to breed in northern Illinois. I do not know of its breeding farther south in Michigan than Bay City, where Mr. N. A. Eddy took a nest and four eggs, June 2, 1885 (Cook, B. of M., p. 138).

Prof. F. H. King examined three specimens and found they had eaten flies, a hymenopterous insect, beetles and larvæ.

163. GENUS SETOPHAGA SWAINSON.

293. (687). *Setophaga ruticilla* (LINN.).*American Redstart.**

Synonym, REDSTART.

Adult Male.—Above, and throat and breast, lustrous black; bases of all the quills, except the first and last, salmon; bases of all the tail feathers, except the middle pair, salmon; sides of breast, vermillion-red; belly, white, tinged with reddish; bill and feet, black. *Adult Female*.—Above, olive-green; below, throat and breast, brownish-white; the salmon and red replaced by yellow; spot in front of, and ring around, eye, grayish-white. *Young*.—Similar to female. This species requires three years for the male to acquire full plumage; consequently they are to be found in all stages between the immature and perfect plumage.

Length, 4.75-5.75; wing, 2.40-2.55; tail, 2.30-2.45.

RANGE.—America, from Ecuador and West Indies to Hudson Bay and Mackenzie Valley (Ft. Simpson); rarely west of Rocky Mountains. Breeds from North Carolina and Missouri, north.

Nest, in fork, on limb of tree or sapling, 6 to 20 feet up; of bark shreds, grass and weeds, lined with hair or plant down. *Eggs*, 3-5; white, greenish-white or bluish-white, spotted, mostly at larger end, with brown and lilac; .63 by .48.

The American Redstart is one of the characteristic birds of the woodland. Wherever there are woods, it may be found at the proper seasons. It is generally common, and in the northern part of the State is abundant. In some of its habits it much resembles the Hooded Warbler. Instead of keeping near the ground, it frequents all kinds of woody growth, from lowest bush to tallest tree. While it makes its home among the dense forest, at times it may be found in little fringing woods or shaded glens, and, during the spring migrations, it occasionally comes into the orchards. Its song, as given by Nuttall, is 'tsh, tsh, tshee, tshè, tshe, tshea, varying to that of the Yellow Warbler, which he interprets as 'tsh, 'tsh, 'tsh, tshitshee. It is a wandering minstrel, giving its song free as air for all who are in the woods. It does not skulk; it is not shy, but, through the bushes at one's feet or through the branches overhead, it pursues its way, now seizing a caterpillar, then chasing a moth or dashing into a swarm of gnats or flies. Its wings are carried partly open, its eye is active, its tail opens and closes, showing with each movement its beautiful coloration—a fan of salmon and black. The name little fantail would be an appropriate one for it.

Its habits combine those of the Flycatchers and the Warblers, and the wingless insects upon the trees are in as much danger as are the flies beneath the shade. Among other insects, they are known to prey upon ichneumon flies, moths, caterpillars, beetles, leafhoppers (King, Geol. of Wis., I., p. 510).

Sometimes it arrives in spring by April 15; again it does not appear before May 5, while, in the northern part of the State, it may be ten days later than those dates. At Richmond it arrived April 15, 1897; at Brookville, April 20, 1896, May 5, 1893; Bloomington, April 21, 1885, May 12, 1886; Greensburg, April 29, 1897, May 8, 1893; Frankfort, April, 16, 1896, May 2, 1894, and 1895; Lafayette, April 29, 1897, May 8, 1893; Sedan, April 30, 1894, May 7, 1889; Petersburg, Mich., April 24, 1897, May 14, 1893; Plymouth, Mich., April 30, 1896, May 6, 1894; Chicago, Ill., May 2, 1896, May 17, 1897. The year 1896 they arrived unusually early. In 1893 their movements were early in the southern part of the State, and very late northward. The year 1895 was medium early. I have seen them begin to pair by May 4 (1882), and May 15, of the same year, I found a nest. Prof. Evermann notes a nest and eggs from Carroll County, June 13, 1883, and Messrs. L. A. and C. D. Test found a nest and four eggs in an elder bush, 6 feet up, at Lafayette, June 15, 1892. The nests usually are placed from ten to thirty feet high in the fork of a limb. In the northwestern part of the State they are very numerous and may be found breeding in almost every patch of oak timber of any size.

Although so numerous as to be a nuisance to the collector, so often are they in front of his gun when it is discharged during the Warbler season, it is a source of pleasure to him who likes to study their busy life; they are unknown to the average person, as are the inhabitants of the planet Mars, for to him has not been given the power of seeing. But some years even the initiated notice their absence, for their numbers, for some reason, are very few. In 1886 Prof. W. S. Blatchley noted their extreme scarcity at Bloomington. The spring of 1894 they were very rare. None were found that year at Lafayette (Test); they were unusually scarce at Sedan (Mrs. Hine); but one was seen at Greensburg (Shannon); and but two were reported from Bicknell (Chansler). In August they begin to move. Their numbers are increased by those from the north, and through September they are found, with other migrants, making their journey southward—a time of feasting and good-fellowship. The first heavy frosts bid them depart, and they are gone. The latest records I have are: Greensburg, September 16, 1894; Bicknell, September 4, 1895; Lafayette, October 3, 1896; Sedan, October 11, 1889; Chicago, Ill., October 1, 1895.

XLVII. FAMILY MOTACILLIDÆ. WAGTAILS.

 α^1 . Tail shorter than wing; usually much streaked below.

ANTHUS. 164

164. GENUS ANTHUS BECKSTEIN.

Subgenus ANTHUS.

294. (697). Anthus pensylvanicus (LATH.).**American Pipit.**

Synonym, AMERICAN TITLARK.



Bill and foot of American Pipit. Natural size.

Adult.—"Points of wings formed by the four outer primaries, the fifth being abruptly shorter; hind claw, nearly straight, nearly or quite equal to its digit; above, dark-brown, with a slight olive shade, most of the feathers with dusky centers; eyelids, line over eye, and under parts, pale buffy or ochrey-brown, variable in shade; breast and sides of neck and body, thickly streaked with dusky; wings and tail, blackish; inner secondaries, pale-edged; one or more outer tail feathers, wholly or partly white." (McIlwraith).

Length, 6.00-7.00; wing, 3.20-3.50; tail, 2.65-2.83.

RANGE.—North America, from Guatemala and Bermudas to Arctic Ocean. Breeds from Colorado, above timber line on mountains, and Labrador, north. Winters from southern Illinois and Nevada, south.

Nest, of grass and moss, on the ground. *Eggs*, 4-6; whitish, almost hidden by thick specks of brown; .78 by .57.

The Titlark, familiar to every plowman in early spring, is one of those birds that frequent the wet fields in flocks and give forth a mellow *pee-de, pee-de*, as they rise and when on the wing. They arise from the meadow and frequently fly a long distance, or ascend to a great height, and, after various evolutions, return almost to the spot from which they started. One who is acquainted with their call can recognize them by it as they pass overhead, even when they are out of sight. While sometimes a few individuals, or a few pairs, are asso-

ciated together, they are generally found in flocks of from twenty to a hundred birds, frequenting meadows, open pastures, fields, prairies and the shores of lakes. They are abundant migrants, and in the southern part of the State may occasionally be winter residents. They have been reported from southern Illinois in winter. In southern Indiana they appear in force some years as early as March 3. Although they move about a great deal, they make slow progress northward. They were first noted at Brookville, March 3, 1893, and April 19, 1889; at Spearsville, March 6, 1894; Wabash, March 16, 1894; Lafayette, April 1, 1892; Richmond, April 22, 1897; Kouts, April 15, 1894; Plymouth, Mich., April 24, 1896, May 2, 1893; Chicago, Ill., April 25, 1896. The latest spring records are Richmond, May 4, 1897; Spearsville, May 10, 1894; Wabash, May 15, 1894; Plymouth, Mich., May 24, 1892. Sometimes before they leave in the spring they begin mating.

Late in September they become common about the lower end of Lake Michigan, remaining until well into October and sometimes into November. They were present in Cook County, Ill., from September 26 to October 3, 1896; from September 28 to October 19, 1895. The latest records I have are as follows: Liverpool, Ind., October 18, 1895; Chicago, Ill., November 3, 1894; Plymouth, Mich., October 20, 1892. At English Lake, Ind., November 16, 1892, hundreds of Titlarks were seen rushing along in flocks of twenty to a hundred, over the marshes (Deane).

XLVIII. FAMILY TROGLODYTIDÆ. WRENS, THRASHERS, ETC.

*a*¹. Rictal bristles well developed; wing 3.50 or more.

*b*¹. Tail longer than wing.

*c*¹. Bill not shorter than middle toe without claw; our species brown above.

HARPORHYNCHUS. 167

*c*². Bill decidedly shorter than middle toe without claw.

*d*¹. Tail partly white.

MIMUS. 165

*d*². Tail with no white.

GALEOSCOPTES. 166

*a*². Rictal bristles not evident; bill not notched; wing less than 3.50.

*e*¹. Back streaked lengthwise; outer tail feathers reaching little beyond the tips of lower tail coverts.

CISTOTHORUS. 170

*e*². Back not streaked lengthwise; outer tail feathers reaching decidedly beyond the tips of longest lower tail coverts.

*f*¹. Lower mandible curved downward; back without crossbars; superciliary streak distinct.

THRYOTHORUS. 168

*f*². Lower mandible straight; back with more or less distinct crossbars; no distinct superciliary streak.

TROGLODYTES. 169

SUBFAMILY MIMINÆ. THRASHERS.

165. GENUS MIMUS BOIE.

295. (703). *Mimus polyglottus* (LINN.).*Mockingbird.**

Mockingbird.

(Judd.—Year Book, United States Department of Agriculture, 1896, p. 415.

Adult.—Above, ashy-gray; below, whitish; wings and tail, blackish, the former with two white wing-bars and large white spot at base of primaries, latter with one or three outer feathers more or less white; bill and legs, black.

Length, 9.00-11.00; wing, 4.10-4.90; tail, 4.50-5.75.

RANGE.—North America, from Mexico (Tehuantepec), and Bahamas, regularly to southern Indiana, Maryland and Colorado; rarely to Massachusetts, Maine, Ontario, northern Illinois and Wyoming. Resident, and breeds throughout its usual range.

Nest, of twigs, weeds and grass, lined with grass and roots; in bush or tree, often in thicket or orchard; sometimes in corner of fence. *Eggs*, 4-6; pale greenish-blue, spotted with chocolate and yellowish-brown, often mostly grouped at larger end; .97 by .69.

The Mockingbird is well known in song and story, but as a native bird, to most of the people of Indiana, it is unknown. Other birds are called by its name, sometimes with a qualifying term. The Catbird is called the Carolina Mockingbird, the Brown Thrashers, the Brown or English Mockingbird, though why English, I cannot imagine. These birds are classed with our famous bird because of their musical ability, but the Loggerhead Shrike is often called Mockingbird because in its flight it somewhat resembles that species. Often the present bird is called the Southern Mockingbird.

In the lower Wabash Valley it is a resident, at least north to Terre Haute, but is much more common in summer. Elsewhere in the southern half of the State, it is a rare summer resident, and farther north it is of accidental occurrence, extending even into Michigan. There they develop the migratory habit, passing a little further south usually in winter, although some of them seem to become vagrants, wandering at that season in the opposite direction. In the southeastern part of the State it has been reported as breeding at Guilford, Dearborn County (Hughes). Dr. Haymond noted its occurrence in Franklin County (Ind. Geol. Rept., 1869, pp. 219, 220), and June 29, 1880, I obtained young scarcely able to fly, within the corporate limits of Brookville. In Monroe County they breed, but are rare (Blatchley, Evermann), while in Vigo County they breed commonly (Kendrick). They seem to range farther north in numbers in the prairie districts of Illinois and western Indiana than farther eastward. In addition, they have been reported as breeding in the following counties: Posey (Elliott), Knox (Ridgway, Chansler), Gibson (Ridgway), Floyd (Yenowine). Prof. Blatchley found it in Vigo County, February 14, 1888, and Prof. Evermann in the same county in January. Mr. H. K. Coale informs me he found one in Starke County, January 1, 1884. They have also been reported from the following counties: Brown, March 10, 1892 (Barnett); Putnam, 1888 (Clearwaters); Cass, Logansport, spring of 1881 (Prof. E. E. Fish); Hamilton, May 13, 1897 (Brokaw). Prof. E. L. Moseley reports one from Sandusky, O., May 20, 1893, and Mr. C. H. Morris has written me fully of a pair nesting on the rail of a fence near McConnelsville, O., in June, 1896. He says there were also two other pairs in the same neighborhood.

Mr. Morris tells me the young were taken from the nest and put into a cage and left exposed. The parents fed them, and four days after they were taken began building a new nest, also on the fence, some thirty yards from the first. They also continued to care for the young in the cage.

When they appear in a new locality for the first time, their remarkable voices soon attract attention. They sing by day and also on moonlight nights; on the wing as well as in the trees. There are other birds that far exceed it in melody and surpass it in sweetness, but as a mocker it is without a peer. At morning or evening, from the top of a tree, a fence stake, or a wheat stack, it begins its marvelous imitations. It may begin with the notes of a Bobwhite, then follow with the song of a Carolina Wren, and succeed these with recognizable productions of the Whip-poor-will, Robin, Wood Thrush, Phoebe, Cardinal, Red-headed Woodpecker, and Flicker. It seems to

have practiced on nearly all the bird songs and calls in the neighborhood and confidently undertakes their reproduction. The Mockingbird prefers the neighborhood of residences, the vicinity of orchards, groves and trees along fences. Sometimes it builds in vines about houses. When a pair take up their residence about a farm-house, they are valuable in assisting in keeping predaceous birds away. They are great fighters. No Hawk or Crow can come about the premises without a conflict. They are also valuable as insect destroyers. Throughout the breeding season and, in fact, all summer long, they live chiefly upon insects. Prof. Forbes noted that sixty per cent. of those he examined consisted of orthoptera (grasshoppers, crickets, etc.). They also had eaten spiders, harvestmen, beetles, including curculios, bugs and ants.

There was no evidence that they had eaten fruit (Bulletin No. 3. Ill. S. Lab., N. H., pp. 415, 416). Fifteen specimens examined by Mr. Judd were principally taken in autumn and winter, when the proportion of vegetable food is the greatest. Of this food they had eaten "the skin and pulp of some large fruit, together with seeds or berries of sumac, smilax, black alder, poison ivy, Virginia creeper, red cedar, pokeberry, mulberry and bayberry. The animal food consisted wholly of spiders and insects. Among the latter were ants, caterpillars, beetles and grasshoppers" (Year Book U. S. Dept. of Agr., 1895, pp. 415, 416).

166. GENUS GALEOSOPTES CARANIS.

***296. (704). Galeoscoptes carolinensis (LINN.).**

Cat Bird.

Adult.—Above, dark slate-color; somewhat lighter below; crown of head and tail, black; wings, but little shorter than tail; under tail-coverts, dark chestnut.

Length, 8.00-9.35; wing, 3.45-3.75; tail, 3.70-4.25.

RANGE.—E. North America, from Panama and Cuba north to British Columbia and Saskatchewan; rare west of Rocky Mountains. Breeds from Gulf States north. Winters from Illinois south.

Nest, in bush or low in tree; of twigs, bark, grass, leaves, strings and rags. *Eggs*, 4-5; bluish-green; .98 by .75.

The Catbird is too well known a summer resident to require an account of its habits. He goes little farther south than our southern boundary, as it is sometimes a winter resident in southern Illinois. Every boy who lives in the country or ranges the fields near some small town knows this plainly-clad, many-voiced bird, and can give a

good account of its doings. He can tell of his own prejudice against it, which is but an expression of a general antipathy to this familiar bird. Why this is so, I am sure I cannot tell, for the Catbird is deserving of respect and good treatment.

They frequent swamps, thickets, bushy ravines and similar places in the less settled localities, but are most abundant where the country is more thickly populated, frequenting gardens, orchards, briars, vineyards, lawns, and even coming into our towns.

The Catbird is not a poor singer. Many are the utterances he makes, ranging from his mewing call among the hedges to his ecstatic love song from the top of a neighboring tree.



Cat Bird.

(Judd.—Year Book, United States Department of Agriculture, 1895, p. 407.)

Its notes have attracted many a singer and made of him an admirer. My good friend, Prof. W. H. Venable, of Cincinnati, O., has been an appreciative auditor and has fitly pictured him in verse, a most difficult task, which he has satisfactorily accomplished.

When the first ones arrive after the winter is past, they frequent the thickets, hedges and small fruit bushes, and are songless. They appear some years in southern Indiana before the end of March, but generally it is well into April before they are seen, and near the end of that month before they reach the Michigan boundary. The year of 1896 some of them arrived in the southern part of the State at an unprecedentedly early date. But the migration of the greater number was stayed until near the usual time. That year they appeared

at Ellsworth, March 26; at Dunreith, March 30; Greensburg, April 1, and Sandusky, O., April 11. They, however, were not noted at Lafayette until April 26, at Laporte until April 25, or at Chicago until May 2. In 1893 the first one was noted at Brookville, April 20; at Greensburg and Moore's Hill, April 26; Sandusky, O., May 6; Laporte, May 8.

In the Wabash Valley they move earlier than in the southeastern portion of the State. The severe storm of May 20 and 21, 1883, destroyed many. They begin mating not long after arrival. Prof. W. P. Shannon found a nest begun April 30, 1896, and another pair began their home next day. The latter nest was completed and one egg laid May 13. An egg was laid daily. I have found its nest and eggs May 23 (1883), and Prof. Evermann found one in Carroll County, May 21. I found young just able to leave the nest July 24, 1896. After nesting they cease singing, usually towards the end of June or early in July. While with us they vary their diet. At times they eat many insects, and again they live largely upon vegetable food. Of 213 stomachs examined by Mr. Sylvester D. Judd, 44 per cent. of their contents was insects and 56 per cent. vegetable food. Ants, beetles, caterpillars and grasshoppers constituted three-fourths of the animal food, the remainder being made up of bugs, miscellaneous insects and spiders. One-third of the vegetable food consisted of such fruits as are cultivated, though they may have been of wild growth, strawberries, raspberries and blackberries. The rest was mostly wild fruits, including cherries, dogwood, sour gum, elderberries, greenbrier, spice berries, black alder, sumac and poison ivy (Year Book U. S. Dept. of Agr., 1895, pp. 406-411). The Catbird, while it eats much fruit, does much good. The fruit season is not long, while the insect crop is abundant throughout all its stay with us. (Also see Forbes' Bulletin No. 3, Ill. State Mus. of N. H., pp. 107-118; King, Geol. of Wis., I., p. 477.) After the song season is past, attention is not drawn so much to this inhabitant of tangled thickets, which grow more rank and impenetrable to man, yet yield an increasing supply of such food as Catbirds like. In September they begin to leave, but still some are found well into October. Brookville, October 4, 1884; Greensburg, October 11, 1894.

167. GENUS HARPORHYNCHUS CABANIS.

Subgenus METHEROPTERUS Reichenbach.

297. (705). Harporhynchus rufus (LINN.).*Brown Thrasher.****Synonyms, BROWN THRUSH, TAWNY THRUSH, BROWN MOCKINGBIRD, FRENCH MOCKINGBIRD, ENGLISH MOCKINGBIRD.****Brown Thrasher.**

(Judd.—Year Book, United States Department of Agriculture, 1885, p. 412.)

Adult.—Above, rufous; wings, with two white bars; below, white, tinged more or less with buff, streaked with dark brown, except on the chin and middle of the belly.

Length, 10.50-12.00; wing, 4.10-4.60; tail, 5.00-5.75.

RANGE.—Eastern North America, from eastern Texas and Florida north to Maine, Ontario and Manitoba. Breeds throughout its range. Winters from Illinois and Virginia south.

Nest, in bush or vine, low down, sometimes on ground; of sticks, leaves and rootlets. *Eggs*, 4-5; greenish or soiled white, more or less covered with reddish-brown dots; quite variable in pattern; 1.03 by .80.

Common summer resident, doubtless some years remains in the extreme southern part of the State all winter, as, perhaps, the last mentioned species also does more rarely. Both occasionally winter in southern Illinois. The Brown Thrasher is a shy and retiring inhabitant of thickets and bushy land, therefore is liable to be overlooked before its season of song begins. In its migration it skulks along

through close cover, apparently moving earliest in the river valleys. In the Wabash Valley it migrates earlier than elsewhere. The earlier arrivals seek the greater expanses of the valley where there is alike shelter from cold winds and considerable exposure to the sun. There they may be found sometimes from one to two weeks earlier than in nearby neighborhoods. In the extreme southern part of the State they appear in March; in the middle, usually from March 17 to April 1, and in the extreme northern portions, usually from April 1 to 15. There is a difference of about a month between the arrivals at Bicknell, Ind., and Chicago, Ill., and Petersburg, Mich. The Brown Thrasher was observed at Hanover, February 25, 1897, by Prof. Glenn



Head of Brown Thrasher. Natural size.

Culbertson. This is the earliest it has been noted in the State. It was reported from Bicknell, March 8, 1894, and March 28, 1895; Spearsville, March 17, 1894, March 31, 1895; Greencastle, March 22, 1894, April 3, 1893; Brookville, March 24, 1894, April 18, 1881; Richmond, March 30, 1897; Lafayette, March 25, 1893; Laporte, April 1, 1893, April 15, 1894; Dekalb County, April 11, 1896, April 20, 1895; Chicago, April 11, 1896, April 28, 1894; Petersburg, Mich., April 7, 1889, 1893, April 20, 1897.

The spring of 1894 they migrated very early, while in 1893 they moved late over the southern portion of the State, but pushing northward rapidly made early records there. I have observed them mating by March 31 (1884), and sometimes it is kept up until April 23 (1889). Years when they arrive at, or after the average time, they seek at once the old quarters occupied by them no one knows how many years. Those arriving after April 1 are usually paired.

There, upon the topmost limb of honey locust, elm, or oak, the male at once begins a serenade. In the early morning and at late afternoon he mounts his favorite perch and sings by the hour. This song period does not last long. After courtships are over they are heard less and less, until in June they become rare and finally cease. I have found their nest containing eggs at Brookville by April 29 (1881), and Prof. Evermann reports one in Carroll County, May 4, 1885. Usually, they build their nest in a bush in a retired place. I knew a pair to occupy a sweetbrier bush at the side of a well-traveled public road year after year.

May 28, 1897, I saw a nest which was found built on the ground by Mr. C. D. Test, near the site of old Post Ouiatanon, below Lafayette. It was in a rye patch at the foot of a stool of rye, and contained four eggs. He informed me that he and his brother had once before found a nest built on the ground. From there southward in this State I have never heard of a nest being built on the ground. Yet farther north, in the old prairie region, and in Michigan, such nesting sites are not rare.

Mr. Sylvester D. Judd reports an examination of 121 stomachs of the Brown Thrush showed 36 per cent. of vegetable and 64 per cent. of animal food. The latter was practically all insects. Half of them were beetles and the remainder mostly grasshoppers, caterpillars, bugs and spiders. Eight per cent. of its food was small fruits, such as are cultivated, while of grain, perhaps obtained from scattered kernels, but the trifle of 3 per cent. was found. The Brown Thrasher stands its trial with the judgment "useful bird" written on the records (Year Book U. S. Dept. Agr., 1895, pp. 411-415). (As to food, see also Forbes' Bulletin No. 3, Ill. State Lab. Nat. Hist., pp. 118-127.) Prof. Forbes found in an orchard infested with canker-worms that this bird made 23 per cent. of its food of those insects (Rept. Mich. Hort. Soc., 1891, p. 204). Generally they are reported to have left in September, or early October, but some continue with us until November, and possibly longer.

The latest records are from Hillsdale, Mich., September 15, 1894; Plymouth, Mich., September 20, 1894; Chicago, October 2, 1895; Lafayette, September 14, 1895, October 8, 1894; Brookville, October 25, 1894; Greensburg, November 3, 1894; Warren County, September 25, 1897.

SUBFAMILY TROGLODYTINÆ. WRENS.

168. GENUS THRYOTHORUS VIEILLLOT.

α¹. Tail not longer than wings, its feathers all brown with fine black bars.

Subgenus THRYOTHORUS. *T. ludovicianus* (Lath.). 298

α². Tail longer than wings, its feathers mostly blackish, the middle one grayish, barred. Subgenus THRYOMANES Sclater. *T. bewickii* (Aud.). 299



Carolina Wren.

Subgenus THRYOTHORUS.

*298. (718). *Thryothorus ludovicianus* (LATH.).

Carolina Wren.

Synonyms, GREAT CAROLINA WREN, MOCKING WREN, LARGE WOOD WREN.

Exposed portion of the bill shorter than the head. Above, reddish-brown, most vivid on the rump; a whitish streak over the eye, bordered above with dark brown; throat, whitish; rest of under parts, pale yellow-rusty, darkest toward the under tail-coverts, which are conspicuously barred with black; exposed surface of wings and tail (including the upper coverts), barred throughout with brown, the outer edges of tail feathers and quills showing series of alternating whitish and dusky spots; legs, flesh-colored. (B. B. and R.)

Length, 5.25-6.00; wing, 2.18-2.50; tail, 1.80-2.35.

RANGE.—Northeastern Mexico and United States east of Plains: north to Nebraska, southern Michigan, southern Ontario and Connecticut. Resident throughout its range.

Nest, in woods and thickets, in hollows and cavities in logs, stumps, and trees, or in and about buildings; of grass, straw, moss and leaves. *Eggs*, 4-6; white or creamy-white, sometimes pinkish, thickly spotted, principally about the larger end, with reddish-brown; .75 by .58.

The Carolina Wren is the largest Wren in the eastern United States. It is an abundant resident in southern Indiana, decreasing in numbers from there northward in some localities, notably the northwestern and the east central portion of the State, almost or entirely wanting. Northward in some places they are only reported as stragglers or summer residents, while elsewhere they also occur in winter. They are abundant north, at least to Knox (Chansler) and Franklin counties, where they are, if any difference, more numerous in winter. They are common as far as Terre Haute (Blatchley) and rather common at Bloomington (Blatchley), and Lafayette (L. A. and C. D. Test); quite frequent in Morgan County (A. M. Hadley). They are rare at Richmond (E. Test), Spearsville (Barnett), Greencastle (Clearwaters), Wabash (Wallace), Carroll County (Evermann), and Michigan City (Byrkit). They have heretofore been rare in Dekalb County, but Mrs. Hine informs me they are increasing in numbers, and are found both winter and summer, and breed.

At Petersburg, Mich., Mr. Jerome Trombley noted one bird in May, 1889, and he said he had seen but one other bird in a period of fifteen years; and in 1892 a pair nested there. There is a general increase in their numbers and extension of their range. May 19, 1887, I found them in Parke County. Mr. V. H. Barnett reports them tolerably common in Vermillion and Warren counties in August and September, 1897. The winter of 1895-6 for about four weeks from February 27 to March 24, 1896, these Wrens seemed to all be absent, about Brookville. Other years they have stayed through the severest weather, even perishing from cold. January 4, 1884, I found one frozen. They frequent both town and country. Ten to fifteen years ago this was the House Wren of the Whitewater Valley. They nested more often about houses and outbuildings than in thickets, brush piles, fence corners and fallen timber. Now it is changed. Bewick's Wren has appeared upon the scene and has become the domestic Wren.

They remain paired throughout the year, and the breeding season appears to extend almost the year around. I have known them to begin singing February 3 (1892), and mate at once. March 1, 1889, I found them house-hunting. In 1884 a pair built their nest in a fleece of wool that hung on the back porch of my house, within two feet of the door. The nest was begun March 13, was almost finished March 19, contained one egg March 23; the fifth and last egg was

laid March 29. The bird began sitting March 30; four eggs were hatched April 11, and the young left the nest April 25.

Mr. G. R. King informs me of a pair that two successive years nested in the winter in a box beneath a shed adjoining his drug store in Brookville. Both years he examined the nest. They had four eggs about December 1, 1895. The same site had been used the three preceding springs.

The Carolina Wren has several songs. It is a noisy bird at all times of the year, and one or another of its efforts may be heard any day that is bright and cheerful, and even at times when the clouds are dark and lowering this energetic little fellow would whistle good cheer into one's cheerless feelings.

Kurs-t is its common exclamation. *Whee-o-now, whee-o-now*, or *Jew-Pet-er, Jew-Pet-er*, may give some idea of the elements of its best-known song. This bears some resemblance to the song of the Maryland Yellow-throat. It also has a rendering with four notes, which a little boy once interpreted: "*kick-'er moth-er, kick-'er mother.*" Again, its notes seem to say, *sweet-heart, sweet-heart*, reminding one somewhat of the louder whistling of the Cardinal. He is just as active as he is tuneful, and will not stay long in the neighborhood without making himself known. A large part of the food of this bird is insects and spiders. It searches logs, stumps, fences, among the bushes of gardens and yards, wood piles, outbuildings, everywhere diligently looking for insects. Mr. F. R. Quick told me of a pair of the birds that frequented his premises a few winters ago and became very tame. In January he was splitting some honey locust logs and the Wrens, which sat within three feet of him, would hop down among the sticks when they were split and pick out the larvæ that infested them.

Subgenus *THRYOMANES* Sclater.

***299. (719). *Thryothorus bewickii* (AUD.).**

Bewick's Wren.

Synonyms, LONG-TAILED HOUSE WREN, LONG-TAILED WREN.

Adult.—Above, dark cinnamon-brown; tail, long, middle feathers, grayish, barred with black; outer feathers, black, marked with whitish; rump, with concealed white spots; secondaries only, barred with black; line over the eye, white; below, ashy.

Length, 5.00-5.50; wing, 2.05-2.25; tail, 2.10-2.40.

RANGE.—Eastern United States, from Texas and Georgia to eastern Kansas, eastern Nebraska, southern Minnesota, southern Michigan, southern Ohio. Rare east of the Alleghanies, where it occurs north

to Maryland and Delaware. Breeds throughout its range. Winters from southern Illinois south.

Nest, almost anywhere about buildings, fences, brush piles, logs, etc.; of grass, straw, sticks, etc. *Eggs*, 5-9; white, sometimes pinkish, with fine specks of reddish-brown and lavender; .67 by .50.

Bewick's Wren is a common summer resident throughout the greater part of southern Indiana and in the lower Wabash Valley, at least, north to Knox County, is a resident, though much rarer in winter. They frequent to some extent, fence rows, more open timber land, thickets and orchards, but in many localities outside the breeding range of the House Wren have become the "House Wren." At Brookville they now occupy that position, which was held formerly by the Carolina Wren, and nest about buildings and fences, woodpiles, in short, in all such places as a Wren would select. The recent extension of the range of this species is notable. In 1879 Dr. Wheaton announces it had not been authentically reported from Ohio (Birds of O., p. 230); it was unknown to him that Mr. Chas. Dury took it that year at Cincinnati. It was almost wholly unknown in Franklin County, Ind., until recent years. In 1869 Dr. Rufus Haymond had seen but a few specimens. None were noted from that year until 1877, when Mr. E. R. Quick identified several specimens. From that date to 1881, an occasional one was seen. Since the last mentioned year, however, when they became common, they have been annually increasing in number, and now they are abundant. The spring of 1897, I found six pairs breeding in an area of one-half mile by a mile, in Brookville. Up to 1890 it had reached Vigo and Putnam counties, where it was rather common, and had been reported from Marion County. North of the points named it was unknown.

It was first noted at Lafayette in 1890, where a pair bred (Dr. F. C. Test), and they became common in 1892 (L. A. and C. D. Test). They were first reported from Wabash in 1891, and were common in 1894 (Wallace). One was seen at Springport, Henry County, April 29, 1894 (Williamson). They were first reported and said to breed at Petersburg, Mich., May 15 and 16, 1894. They were still rare there in 1897 (Trombley). The first record from Richmond, Ind., is in the spring of 1897, and it is given as rare (Hadley). I believe they are extending their winter residence northward, and beyond that limit the date of their spring migration is becoming earlier. They were not observed at Brookville from 1877 to 1888 before April 1, but in 1889 they appeared March 1, and were common by March 7. Since then they have generally appeared in March. They usually arrive wherever found in this State before the middle of April. They mate

soon after arrival, in fact, some years arrive mated. I have seen them looking for a nest site March 25 (1897). Prof. Shannon found a nest containing one egg at Greensburg, April 12, 1896, and I have found young just out of the nest early in July. They return every night to roost in the nest after they are able to fly. The period of incubation is fourteen days. They persistently return to the same nesting place. Mr. John Wright, of Bartholomew County, told me of a pair that nested on an old mantel in a deserted house three years in succession. The first two years they built in a tin can, but the third year, that having been removed, they built on the mantel. Mr. E. R. Quick informs me in 1897, at his house, a pair nested and reared their first brood of six in a gourd. The second set of 5 eggs were laid in a ball of twine in a binder. Then the female was interrupted. She laid another set of six in the gourd first occupied; with these were put the five found in the binder, and out of the eleven were hatched eight young, making a total of fourteen young hatched by one pair of Wrens in a season. The same careful observer in the spring of 1891 found a pair building a nest in the drawbar of a freight car, which was standing on a siding at Brookville. Their songs were heard at Brookville March 30, 1896, and in 1897 continued until August 30. In fact, one sang a few notes October 14, 1897, which is the latest I have found them in the fall. They have a finer rattling note than that uttered by the Carolina Wren. The common alarm note is *plit*. It has several songs, all accompanied by a greater or less number of stridulations. I give a few attempts to interpret its songs. But I must confess that often the attempted interpretations by others convey no meaning to me. One song I have written *chip, chip, chip, te-da-a, te-dee*; another, *cheep, cheep, che-we-e-e-e*. A third song sounds something like *whee-to-weet, a-her, che-chee*; while one of its most familiar efforts seems to be expressed by *chick, click, for me-é, for you*. They, too, are great insect catchers.

169. GENUS TROGLODYTES VIEILLIOT.

*a*¹. Wings folded not reaching end of tail. Subgenus TROGLODYTES.

*b*¹. Above umber brown; back usually indistinctly barred.

T. ædon Vieill. 300

*b*². Above grayish brown; back usually distinctly barred.

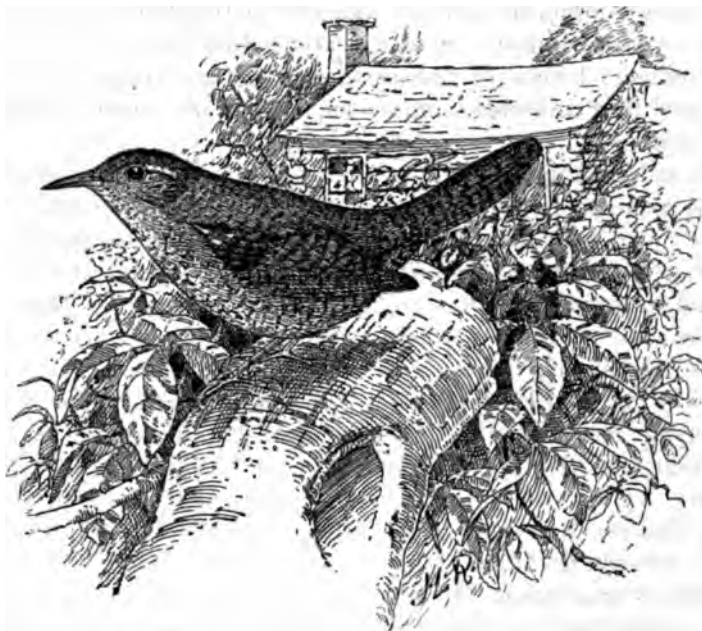
T. ædon aztecus Baird. 301

*a*². Wings folded reaching nearly or quite to end of tail.

Subgenus ANORTHOURA Rennie. **T. hiemalis Vieill. 302**

Subgenus *TROGLODYTES*.***300. (721). *Troglodytes aedon* (VIEILL.).****House Wren.**

Synonym, SHORT-TAILED HOUSE WREN.



House Wren.

(Judd.—Year Book, United States Department of Agriculture, 1895, p. 417.)

Adult.—Above, umber-brown, the head darker, rump and tail decidedly rusty; back usually with indistinct dusky bars (sometimes entirely wanting); wings and tail, distinctly barred; rump with concealed white dot; an indistinct stripe over the eye; sides of head, whitish; below, whitish or grayish, often shaded with brown; sides and under tail coverts, barred with dusky.

Length, 4.25-5.25; wing, 1.90-2.15; tail, 1.72-2.08; bill, .46-.52.

RANGE.—Eastern North America, from Gulf Coast to Maine and Ontario, west to Indiana, Illinois, Missouri and Texas. Breeds from central Indiana, central Illinois, southern Ohio and District of Columbia, north; also in Florida. Winters chiefly south of lat. 35°.

Nest, preferably about buildings, in a hole or box. *Eggs*, 7-9; white, thickly spotted with reddish-brown; .65 by .50.

The House Wren is known over much of southern Indiana only as a migrant, and there may be found in thickets, along fences, about

drift piles or the fringing vegetation of our streams. They are common summer residents, and breed at Richmond, Connersville, Indianapolis, Spearsville, Greencastle, Sullivan, Terre Haute, Wheatland and Vincennes. North of that line, except in the extreme northwestern part of the State, they breed commonly, but south of it rarely nest. Mrs. Hine informs me they first appeared in Dekalb County in 1883, and are now common. In some parts of the State it is local in distribution. I know of two instances where they nested at Brookville, and Prof. Evermann informs me they are rare summer residents at Bloomington.

Mr. Robert Ridgway informs me that this is the species occurring in the vicinity of Wheatland and Vincennes, where Bewick's Wren is also found commonly, but at Mt. Carmel, Ill., this species does not occur, and its place is taken by Bewick's Wren. In general they may be said to breed north of the range of the latter species. They are said to winter north to southern Illinois, and may possibly be found at that season along our southern border. They migrate a little later than the last mentioned species. The earliest date at hand is from Brookville, March 11, 1887; the latest at that station, April 28, 1883. At Spearsville, they appeared March 14, 1897, March 29, 1895; Vigo County, April 2, 1896, April 6, 1897; Sedan, April 13, 1894, May 4, 1895; Laporte, March 31, 1896, April 4, 1894; Chicago, Ill., April 27, 1896; Petersburg, Mich., April 24, 1897, May 5, 1888. They rear two broods in a season. In selection of nesting sites and in many of their habits they are similar to the last mentioned species. These are much more persistent birds. At times it seems that no amount of discouragement will turn them from their plans. Mr. A. H. Kendrick informs me of one which persistently attempted to build its nest in a pump spout at Edwards. He also tells me of another one that built her nest in the air shaft of a coal mine, but the eggs did not hatch. The reason he suggests is that they were chilled by the cold air blasts. Messrs. L. A. and C. D. Test found them building April 29, 1892. Mr. J. O. Snyder reported one breeding April 20, 1886, at Waterloo. On the other hand, I found them breeding at Brookville, July 3, 1888. The song begins soon after arrival, and Mr. Bicknell says it is sometimes continued until August. It is different from that of the other Wrens, yet the listener is impressed when he first hears that no bird other than a Wren could sing such a song. It is very sprightly, consisting of a few loud notes, followed by an exceedingly melodious trill. The decision of those who have studied its foods is that the House Wren is entirely beneficial. Mr. Sylvester D. Judd says of 52 specimens examined, 92 per cent. of their food

was insects and their allies, and only 2 per cent. was vegetable (Year Book U. S. Dept. of Agr., 1895, pp. 416-418). It pays to put up boxes and other nesting sites for these and other friendly birds. They are thus encouraged to build about homes and gardens and in orchards, where their usefulness is greatly increased. They leave in September, but occasionally linger into October. In 1894 the last one was observed at Plymouth, Mich., September 19; at Hillsdale, Mich., September 26; Warren County, Ind., September 11, 1897. In 1886 they were found migrating at Brookville, September 8, and in 1897 one was seen as late as October 5. Mr. Ridgway notes that, in a pair observed, nest building occupied 12 days; egg laying, 8 days; incubation, about 14 days, and 14 days later the young left the nest (B. of Ill., I., p. 96).

301. (721*b*). *Troglodytes aëdon aztecus* BAIRD.

Western House Wren.

Similar to *T. aëdon*, but "above rather grayish-brown, the rump and tail slightly more rusty, and the back and rump generally very distinctly barred with dusky (very rarely plain)" (Ridgway). Averaging larger.

Length, 4.25-5.25; wing, 2.00-2.25; tail, 1.85-2.12; bill, .45-.55.

RANGE.—Western North America, except Pacific Coast, from Mexico (State of Vera Cruz) to Manitoba and Great Slave Lake; east to Minnesota, Illinois and Indiana. Winters from Texas, south.

Nest and eggs similar to the last.

The Western House Wren ranges into northwestern Indiana and, perhaps, other portions of the State, where there were originally prairies, and is there a summer resident. It seems to be especially attracted to prairie districts. Mr. Ridgway notes this form from Illinois also, where he tells me the House Wrens he has seen from the prairie region—Richland County, about thirty miles west of Vincennes, the vicinity of Chicago, etc.—are this form, while at Mt. Carmel, Ill., and Vincennes, Ind., the House Wrens are the eastern form. Farther north in Indiana, where the country is more open, he should expect to find *aztecus*.

Specimens from Vigo County are of the eastern form.

Mr. F. M. Woodruff, of Chicago, informs me that two pairs taken near Hammond, Ind., June 4, 1897, were submitted to Prof. J. A. Allen for examination. He writes they agree with *T. æ. aztecus*, even comparing them with specimens from Arizona. The birds were nesting in an old stump within fifty yards of the electric street car line.

about half way between Hammond and Roby. Specimens from north-western Indiana, also from farther south along the western border of the State, are desirable, in order that the limits of the range of this form may be determined. Doubtless in some localities both forms will be found.

Subgenus *ANORTHURA* Rennie.

302. (722). *Troglodytes hyemalis* VIEILL.

Winter Wren.

Synonym, BUNTY WREN.



Winter Wren.

Adult.—Deep brown above, darkest on the head, brightest on the rump and tail; obscurely waved with dusky, and sometimes with whitish also; tail like rump; wings, dusky, edged with color of back, and dark barred; several outer primaries also whitish barred; a superciliary line and obscure streaks on sides of head and neck, whitish; below, pale brown; belly, flanks and under tail coverts, strongly barred with dusky (McIlwraith).

Length, 3.50-4.12; wing, 1.75-2.00; tail, 1.15-1.40.

RANGE.—Eastern North America. Breeds from mountains of North Carolina, Ohio, Michigan, Illinois and Iowa, northward. Winters from Indiana, Illinois and Ohio, south to the Gulf States.

Nest, in dense woods, about logs or overthrown trees; a ball of moss, lined with feathers or fur. *Eggs*, 5-7; white, with reddish-brown spots; .69 by .50.

The Winter Wren is a common migrant, and over the southern half of Indiana, at least, is a winter resident. It frequents all sorts of places—woods, thickets, bushy fence rows, dark ravines, and even at times orchards, outbuildings and woodpiles. I have seen both this

and the Carolina Wren about my woodhouse at the same time. There are four Wrens, then, that are seen about our homes. The large reddish-brown one—the largest one we have—is the Carolina Wren. The dark brown, slim, long-tailed one is Bewick's Wren. The dark brown, slim, short-tailed one is the House Wren, and the little buntz Wren that apparently has almost no tail is the Winter Wren.

They begin to arrive from their breeding ground, a little farther north, in September. Over most of the northern part of the State they are almost or entirely wanting during the coldest months, but farther south they are to be found all winter, some years scarce, some years common. They are reported as winter residents as far north as the following places: Brookville, Moore's Hill, Greensburg, Bloomington, Greencastle, Carroll County. It probably sometimes winters in Wabash County (Ulrey and Wallace, I. A. S., 1895, p. 158). They arrived at Chicago, Ill., September 28, 1896, and the latest date reported is October 12, 1895. At Sedan, Ind., they arrived September 19, 1894, and were seen there November 6, 1889. They were noted at Lafayette September 13, 1894, which is the earliest appearance in the State. They arrived at Warren County, September 22, 1897; at Brookville, October 8, 1885; at Greensburg, October 7, 1894; at Bicknell, October 3, 1894; at Bloomington, October 4, 1885. The last record in the spring from Bicknell is April 16, 1881; Greensburg, April 2, 1895; Brookville, April 16, 1881; Bloomington, April 18, 1885; Sedan, April 11, 1894; Lafayette, April 21, 1897; Irvington, April 29, 1889; Richmond, May 5, 1897.

This Wren has been found breeding in Ohio (Wheaton); in Michigan (Cook); Ontario (McIlwraith), and Illinois, where Mr. H. A. Klein says he took a nest near Polo (W. W. Cooke, Bird Mig., Miss. Valley, p. 273).

Prof. Evermann thinks it breeds in Carroll County (The Auk, Jan., 1889, p. 29). They are quiet usually. The only sound heard with us is a *churr*. But at their breeding grounds they sing a pretty song. They are most often seen when one is quiet, about a pile of river drift, a stone wall in a thicket; a windfall in the forest, the exposed tree roots and fallen brush along a ravine. There the little investigator may be seen diligently looking for its meal. This it expects to make up of insects, and it has selected a spot where they may be found with least effort. Ants, caterpillars, beetles, dragon flies, moths, spiders, flies and larvæ have been found forming their food.

170. GENUS CISTOTHORUS CABANIS.

α^1 . Bill about half as long as head; no white stripe over eye.

Subgenus CISTOTHORUS. *C. stellaris* (Licht.). 303

α^2 . Bill slender, about as long as head; a conspicuous white stripe over the eye.

Subgenus TELMATODYTES Cabanis. *C. palustris* (Wils.). 304

Subgenus CISTOTHORUS.

303. (724). *Cistothorus stellaris* (LIGHT.).

Short-billed Marsh Wren.

Adult.—Bill very slender, less than a half inch long; "dark brown above; crown and middle of the back, blackish, nearly everywhere conspicuously streaked with white; below, buffy-white, shading into pale brown on the sides and behind; wings and tail, barred with blackish and light brown; flanks, barred with dusky; throat and middle of belly, whitish" (McIlwraith).

Length, 3.75-4.50; wing, 1.72-1.90; tail, 1.58-1.70; bill, .40.

RANGE.—North America, east of Plains, from Gulf States to southern New Hampshire, Ontario and western Manitoba. Breeds locally throughout its range. Winters from Gulf States, south.

Nest, in wild grass, 12 to 18 inches in height, or on ground; placed 8 to 10 inches from top of grass; globular, hole in side, made of dried grass, lined with down of cat-tails or other plants; the growing grass so woven over and around it that it is hard to see. *Eggs*, 5-8; white, unmarked; .63 by .45. Two broods.

The Short-billed Marsh Wren is a migrant and summer resident. It breeds in restricted localities, where the marshes are suitable, and in places is found in some numbers. It is much more numerous in the northwestern portion of the State. They have been found breeding in Putnam County. In the Whitewater Valley I have only found it once. September 22 and 23, 1879, I saw several and took two specimens from a swampy hollow about three miles from Brookville. Mr. Ruthven Deane informs me a nest of this species, containing eggs, was taken by an employe of their club at English Lake, the spring of 1889. In the collection of Mr. G. Fream Morcom, Los Angeles, Cal., is a set of five eggs of this Wren taken at Davis Station, Ind., June 3, 1887. Mr. L. A. Test, of Lafayette, has received an egg of this kind from Mr. B. F. Beekman, who took it from a nest near Brunswick, Lake County, in the summer of 1893. Three nests were found in the rank grass along a small ditch when they were making hay. I am indebted to my friend, Mr. B. T. Gault, of Glen Ellyn, Ill., for the following very carefully prepared notes on the Short-billed

Marsh Wren: "This spring (1889) I made the following observations on the Short-billed Marsh Wren: June 3, several were noted in the grassy marshes near Sheffield, Ind., and two adult birds were taken that day. I was at first attracted by their song, which is altogether different from that of *C. palustris*.

"In the manner of delivery it forcibly reminds one of the song of the Dickcissel (*Spiza americana*), although, of course, it was not near as loud. They were quite shy, but would allow one to approach within forty or fifty feet of them, when they would dart down into the thick grass, from which it was almost impossible to dislodge them. The specimens that I secured were shot from small bushes on the edge of marsh, these being the favorite stands occupied by the males in song. Their stomachs contained the remains of small beetles and other insects; testes were greatly swollen.

"Nine (9) birds in all were seen and heard that day, and which no doubt were nest building. On June 14, I again visited the same locality. Some new and last year's nests were found, and three or four pairs were apparently nesting there. Like all Wrens, I found them to have a very irascible disposition, and they scolded me continually while I was nest hunting. My efforts, however, to secure eggs were unsuccessful.

"Several old nests examined were found to be lined with pieces of wasps' nests, bog moss and vegetable substances. June 28, I visited the marsh again, and soon I learned to my regret that I had overlooked the nests containing eggs on my last visitation (June 14), but which at that period even would have been of little use to me, considering the advanced state of eggs and their extreme fragility. I found in their stead that at least one brood had hatched, one young a day or two from the nest being taken. Another was discovered, but which succeeded in getting away from me in the thick, rank grass. It was quite a while before I successfully located these little fellows, although they were chipping around, seemingly within a foot or two of me, for some time, and at least a half hour was consumed in the search before I was fully rewarded with the capture of one. Two (2) new nests, evidently prepared for the second brood, were found, and a piece of shell from one egg just hatched was picked up in an adjoining marsh the same day. This species is a clever creeper in the dense grass, and is able to move around at a lively rate without showing itself" (Jan. 18, 1892).

Mr. C. E. Aiken writes me that he found them in the marshes bordering sloughs in Lake County in May, 1871.

Dr. J. L. Hancock informs me it was noted at Hammond, April 9, 1887, by Mr. Graham Davis. Mr. H. K. Coale has twice reported it from Lake County: May 9, 1877, and July 4, 1881. July 24, 1894, Mr. Alexander Black obtained a pair of these birds from among the sedge about an old mill pond, near Greencastle. From the actions of the bird, he suspected a nest. The next day he found a nest after some search. It was built in a bunch of grass about eighteen inches above the ground. The nest was made of grass blades worked into the form of a ball, and was covered with the "saw grass" blades which had been drawn and fastened upon the nest. There was a small opening in the side. The nest was freshly built and contained no eggs. From July 24 to September 6, several young Marsh Wrens were taken there, some of them just able to fly. On the last date mentioned, he and Mr. Jesse Earle found a nest and one addled egg. Once before, during migration, these birds had been taken in that county.

Mr. J. R. Slonaker reports it from Vigo County, May 8, 1889.

Mrs. Jane L. Hine noted it April 24, 1888, from Dekalb County.

Subgenus TELMATHODYTES CUBANIS.

***304. (725) Cistothorus palustris (WILS.).**

Long-billed Marsh Wren.

Adult.—Bill over a half inch long; "dark brown above; crown and middle of the back, blackish, nearly everywhere conspicuously streaked with white; below, buffy-white, shading into pale brown on the sides and behind; wings and tail, barred with blackish and light brown; flanks, barred with dusky; throat and middle of belly, whitish" (McIlwraith).

Length, 4.25-5.50; wing, 1.80-2.12; tail, 1.60-1.90; bill, .54.

RANGE.—Eastern North America, from eastern Mexico north to Massachusetts, Ontario and Manitoba; west to Rocky Mountains. Breeds locally from Gulf coast, north. Winters from South Carolina, south.

Nest, an oblong ball of marsh grass, sometimes plastered with mud, attached to reeds, usually above the water, lined with fine grass or vegetable down. *Eggs*, 6-10; chocolate-brown, sometimes marked with darker brown; .66 by .46.

The Long-billed Marsh Wren is an abundant resident wherever there are marshes. Elsewhere it is only a migrant and is rarely seen.

Throughout the northern part of the State, and along the Wabash Valley, wherever there are suitable localities, it breeds in numbers.

I do not know that it has been found elsewhere breeding in southern or central Indiana. Along the Whitewater Valley I have occasionally seen it among the bushes fringing the streams, and even creeping about among the river drift that had accumulated in piles from some previous freshet. They are reported to occasionally winter as far north as southern Illinois. In Indiana, the earliest date I have is from Terre Haute, April 12, 1890. At Brookville I have taken it April 27, 1887, and May 10, 1885. At Bloomington it was noted May 13, 1886; Richmond, May 17, 1897; Dekalb County, May 12, 1890, May 20, 1897; Chicago, Ill., April 15, 1886, May 26, 1897.

They have nothing to draw them aside in their migration. We see only the occasional straggler which falls by the way. The bulk press on to their breeding grounds, where also they get their favorite food. Therefore, the probability is that, could we carefully observe their favorite grounds, we would find they arrive as early, possibly earlier than the scattered data along the route shows. They breed among the sedges, grasses of marshy places and among the reeds in shoals in lakes. They are not confined to restricted localities, where a small company breeds, but are generally distributed among the marshes and about the lakes. They often build quite a number of nests and only occupy one. Mr. J. Grafton Parker says: "Hardly one nest in twenty contains eggs. The birds must build many nests before laying, as the nests are much more plentiful than the birds." This observation is a common one, though the number of false nests varies. Usually from six to a dozen have been found, where I have examined them, to one that was occupied. Mr. E. W. Nelson says: "While the female is incubating, the male is constantly employed upon the construction of several unfinished nests, until often a pair may boast the possession of a dozen unoccupied tenements" (Bull. Essex Inst., Vol. VIII., 1876, p. 97). The last of May I have found their nests in Fulton County, apparently completed, but containing no eggs. Mr. Ruthven Deane has found them breeding abundantly at English Lake in June and July. He has also noted them building August 4, 1889. They raise two and possibly three broods in a season. They have been also reported as breeding in the following counties: Lake, Laporte, Dekalb, Kosciusko, Knox and Gibson (Ridgway), and Vigo (Evermann). The return migration occurs in September and October. They were last recorded from Hillsdale, Mich., September 24, 1894; Cincinnati, O., September 21, 1879; Chicago, Ill., October 19, 1895; Lake County, Ind., October 16, 1896, and Mr. Deane has found them at English Lake as late as October 27.

They have a scraping, scolding note that is most familiar to those who intrude upon their haunts, but also sing a little song that the casual visitor does not recognize.

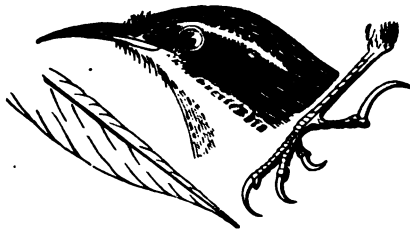
Mr. Bicknell says they cease singing early in August, but have another song period in September or October.

XLIX. FAMILY CETHIIDÆ. CREEPERS.

a¹. Characters same as family.

CERTHIA. 171

171. GENUS CERTHIA LINNÆUS.



Head, foot and tail feather of Brown Creeper. Natural size.

305. (7-6). *Certhia familiaris americana* (BONAP.).

Brown Creeper.

Adult.—Bill about the length of the head; above, dark brown, with a slightly rufous shade, each feather streaked centrally, but not abruptly, with whitish; rump, rusty. Beneath, almost silky white; the under tail coverts with a faint rusty tinge; a white streak over the eye; the ear coverts streaked with whitish; tail feathers, brown centrally, the edges paler yellowish-brown; wings with a transverse bar of pale reddish-white across both webs (B. B. and R.).

Length, 5.00-5.75; wing, 2.40-2.70; tail, 2.30-2.90.

RANGE.—Eastern North America, from Gulf States, north. Breeds from Minnesota, Indiana, Pennsylvania and Maine, north.

Nest, under loose bark of dead tree; of lichens, usnea, moss, feathers, grass and rootlets. *Eggs*, 5-6; profusely spotted with bright brown; .60 by .48.

The Brown Creeper is a very common migrant throughout the State. It is an irregular winter resident in all parts of the State, being much more regular and some winters common southward. In the northeastern part of the State it is known to breed, and may be there a rare resident. At any rate, there its winter range and breeding range meet.

This Creeper is colored so near the markings on the trees that few people see it, and to most persons it is a rare bird. When its piping

notes are known, one realizes that before he was often in a woods peopled with interesting birds, but beyond occasionally seeing one fly from one tree to another, he did not know of their presence. They usually fly from a higher to a lower place; from some distance up on one tree to near the ground on another, and then begin creeping over the trunk, sometimes ascending in an approximately straight line, often climbing spirally, going several times around the tree in making the ascent. Mr. William Brewster says of their song at breeding time: "Their notes are varied and warbling, and somewhat confused; some of them are loud, powerful and unsurpassingly sweet, others are more feeble and plaintive. Their song usually ends with their accustomed cry, which may be represented by *cree-cree-cree-ep*." Their songs we do not hear in southern Indiana, but in March and April, during the spring migration, and in October, when they return, we hear their well-known calls. I found them industriously hunting and uttering their cry October 19, 1896. In the fall they sometimes associate with those little mixed parties of Chickadees, Titmice, Downy Woodpeckers and other chosen spirits, but often then, as they usually do in spring, very often associate themselves with little flocks of Golden-crowned Kinglets. I never saw so many birds of these two species as I did April 12, 1897. The woods were alive with them. They were everywhere. Their tiny voices made music in all parts of the forest growth. In one thicket, where I stood quietly for a few moments to watch the passing of the little birds, I observed at the same time three Brown Creepers on a small tree and six Golden-crowned Kinglets among the bushes, all within thirty feet of me, and very tame. The greater number of them are migrants with us. They begin to appear about the middle of September some years, and most have passed by the latter part of October. They have been reported as making their first appearance at Chicago, Ill., September 13, 1895; Cincinnati, O., September 21, 1897; Warren County, September 15, 1878; Lafayette, Ind., October 2, 1896; Sedan, October 5, 1889; Greensburg, September 27, 1896; Brookville, October 6, 1884.

In the spring, through the last half of March and early April, they are frequently very common. Some of them linger until the last of that month or even into May. They have been noted at Brookville as late as April 21, 1890; Greensburg, April 20, 1895; Cincinnati, Ohio, April 27, 1879; Sedan, April 23, 1889; Lafayette, May 3, 1893. At Bloomington it has been noted as late as May 30, 1888, by Mr. G. G. Williamson. Hon. R. Wes. McBride has given the following account of its breeding in Steuben County: "In my notebook I find the following, under date of May 8, 1882:

'Brown Creeper; taken near Golden Lake, Steuben County, Indiana. Nest in crevice, where the bark had started from a dead tree, about 4 feet from the ground, in a swampy tract in "Crane Town." Nest composed of sticks, bark and feathers. Six eggs, beauties. Incubation commenced. Embryos half developed.' I have a very distinct recollection of the matter. The 'Crane Town' referred to in the matter is a heronry which we were exploring. The water was high, and we were in a boat. I placed my hand against a tree to push the boat past it, when the bird flew off the nest, which was within a few inches of my hand. The bird remained near me until after I had secured the eggs and examined the nest. The appearance and characteristics of the Brown Creeper are so marked that it could hardly be mistaken for any other bird. I could not possibly be mistaken in its identification. In addition to this, the location and construction of the nest and the eggs themselves are all typical and characteristic.

"Another nest and set of eggs were taken in May, 1883, at Fox Lake, near Angola, by my sons, Charles H. and Herbert W. The identification in this case was as satisfactory and unmistakable as in the other. Since that time, while I have frequently seen them during the breeding season, both in Steuben and Dekalb counties, I have found no other nests."

Mr. H. W. McBride thinks it also breeds in Dekalb County. It has been found breeding in about the same latitude in Monroe County, Mich. (Cook, B. of M., p. 145), and Mr. Otto Widmann found its nest and eggs in Missouri, the spring of 1895.

It has been found, in winter, tolerably regularly in the following counties of southern Indiana: Franklin, Decatur, Brown, Monroe and Knox. Some winters it is found also in Tippecanoe, Carroll and Wabash counties. The winter of 1896-7 they remained in the vicinity of Chicago and were reported from Kouts and Miller's, Ind., by Mr. J. G. Parker, Jr., and they remained the winter of 1889-90 at Sedan, Dekalb County, where they were observed by Mrs. Jane L. Hine. They also have been noted in Michigan at all seasons (Cook, B. of M., p. 145).

Their principal food is insects, particularly those species affecting the trunks of trees. Among other things, they have been found to have eaten beetles, bugs, other insects, spiders, pine seeds and fungi.

L. FAMILY PARIDÆ. NUTHATCHES AND TITS.

α^1 . Bill long and slender, the lower mandible slanting upward; tail short.

Subfamily SITTINÆ. SITTA. 172

α^2 . Bill short and stout; tail long. Subfamily PARINÆ.

PARUS. 173

SUBFAMILY SITTINÆ. NUTHATCHES.

172. GENUS SITTA LINNÆUS.

α^1 . White below.

S. carolinensis Lath. 306

α^2 . Rusty brown below.

S. canadensis Linn. 307

*306. (727). *Sitta carolinensis*. LATH.

White-breasted Nuthatch.

Synonyms, WHITE-BELLIED NUTHATCH, CAROLINA NUTHATCH, TOMTIT.

Adult Male.—Above, bluish-gray; crown, glossy black; secondaries, marked with black, the quills with some white; side of head, stripe over the eye and most of the lower parts, white; the lower tail coverts, partly rufous; tail, black and white. *Adult Female*.—Similar, but top of head, dark gray, black behind.

Length, 5.25-6.15; wing, 3.50-3.75; tail, 1.95-2.20.

RANGE.—Eastern North America, from Georgia and Texas north to New Brunswick, Ontario and Minnesota; west to Kansas. Resident throughout most of its range.

Nest, in natural or artificial hole in tree or stub, 4 to 90 feet up; of hair, fur, feathers, moss, bark or lichens. *Eggs*, 8, sometimes 5 or 7, rarely 9 or 10; white, creamy-white, pinkish-white, spotted with chestnut, hazel or vinaceous, and distinctly or obscurely with lilac-gray; markings heavier at larger end; .72 by .56. Often two broods.

The Carolina Nuthatch is a common resident throughout Indiana. In the extreme northern portion of the State, they are fewer in numbers during the winter. All that season they are to be found, keeping company with Chickadees, Tufted Titmice, Downy Woodpeckers, Juncos and Tree Sparrows. An interesting group, moving about for the sake of food and enjoying each other's company. They are to be found at this season almost everywhere, clambering over fences and creeping about trees, as often with the head down as otherwise, diligently searching for insects, which had thought they had found secure winter retreats. The energy with which the Nuthatch hunts and the vigor with which it pursues an insect, often pounding like a Woodpecker to detach a piece of bark or break through into a burrow, shows that even those who think themselves safe are sometimes deceived. Their work, like that of the Brown Creeper and the Red-breasted

Nuthatch, is to keep in subjection the host of insects that infest the trunks and limbs of trees. They have a large contract on hand and are kept continually busy. Their call is *yank, yank*, which may be heard at most seasons, being almost or wholly wanting in late summer. In spring they vary this with a monotonous calling, which they may think is a song. Mr. F. M. Chapman gives it as a "tenor *hah-hah-hah-hah*—sounding strangely like mirthless laughter."

In April, after the mixed company has broken up, each member to attend to business of his own, the Nuthatches become more retiring, and frequent the woods, groves, thickets and timber in the river bottoms, where, in holes in snags, stumps, trees, fenceposts, etc., they nest. Sometimes they make homes about our orchards, and Mr. L. F. Meyer tells me of a nest in Lake County, built in a house which was occupied by a family having ten children. Prof. F. H. King examined 25 specimens; 14 had eaten 32 beetles; 1, 2 ants; 1, 2 caterpillars; 1, 2 grubs of a beetle; 1, a spider; 1, a chrysalid; 1, small toadstools; 5, acorns; 1, corn (Geol. of Wis., I., p. 486). This beneficial species should be carefully protected and encouraged. Placing suitable nesting sites about country homes will doubtless lead them to seek these if they are in retired places, as the area of woodland, year after year, diminishes.

***307. (728). *Sitta canadensis* LINN.**

Red-breasted Nuthatch.

SYNONYM, RED-BELLIED NUTHATCH.

Adult Male.—Smaller than last; above, bluish-gray; crown, glossy black; stripe over eye, white; black stripe through the eye; secondaries, not marked with black; below, rusty or ochraceous; throat, white; tail, black and white. *Adult Female*.—Similar, but crown and stripe through the eye, dark-gray.

Length, 4.12-4.75; wing, 2.60-2.85; tail, 1.58.

RANGE.—North America, from Gulf States north to Hudson Bay Territory. Breeds from Virginia (in the Alleghany Mountains), Maine, northern Michigan and Manitoba, northward. Winters from Minnesota and northern Michigan, southward.

Nest, in a hole excavated in an old, well rotted snag, 4 to 35 feet up; of chips, lined with finely shredded bark or fine grass. *Eggs*, 3-6; rosy-white, thickly dotted or speckled with reddish-brown, sometimes very pale; markings mostly at larger end; .60 by .47.

The Red-breasted Nuthatch is a bird of very irregular and peculiar distribution. It is usually a rather common migrant late in April and

early in May, and again in September. Sometimes, however, it will be found migrating early in March, and will be abundant in October. Other years, it will occur locally as a rare winter resident, not only as far north as our northern boundary, but still farther north in Illinois—Lake Forest (Parker), and on beyond to Palmer, on the upper peninsula of Michigan, where, Mr. O. B. Warren informs me, it is a permanent resident. It also sometimes breeds in Indiana. Dr. A. W. Brayton has so reported it from the northern part of the State, and Prof. B. W. Evermann found young just able to fly in Carroll



Head of Red-breasted Nuthatch. Natural size.

County, in August, 1878. About Brookville I have found them, some years, quite common between April 30 (1885) and May 15 (1879). Then they frequent the denser woodland and may be readily recognized either by sight or sound. Their drawled, nasal utterance is quite different from that of the larger species, just mentioned. It has been expressed by Mr. F. M. Chapman as *yna, yna*. It has been taken during the spring migrations at Lafayette, March 13, 1897, May 4, 1897; English Lake, March 18, 1894; Greensburg, March 29, 1896, May 9, 1893; Spearsville, April 11, 1897; Bloomington, April 21, 1885; Carroll County, May 3, 1883, May 7, 1885; Richmond, May 16, 1897.

In the fall they have been noted at Chicago, Ill., August 25, 1886; Lafayette, Ind., August 30, 1895, October 31, 1896; Wabash, September 15, 1891; Cincinnati, O., September 15, 1878; Bicknell, October 11, 1895. They were found wintering at Greensburg the winter of 1896-7 (Shannon); at Bloomington, the winters of 1882-3 and 1885-6 (Blatchley); Spearsville, 1894-5 (Barnett); Lafayette, 1895-6 (Test); Waterloo, 1888-9 (H. W. McBride); Cook County, Ill., 1894-5 (Parker), and were very abundant there the winter of 1866-7 (Aiken).

Their habits are much similar to those of the last mentioned species. Like it, they are great creepers and are diligent insect hunters.

SUBFAMILY PARINÆ. TITMICE.

173. GENUS PARUS LINNÆUS.

- a*¹. Head crested. Subgenus LOPHOPHANES Kaup. **P. bicolor** Linn. **308**
*a*². Head not crested. Subgenus PARUS.
*b*¹. Tertiaries and greater wing coverts without distinct whitish edgings; wing under 2.50. **P. carolinensis** Aud. **310**
*b*². Tertiaries and greater wing coverts with distinct whitish edgings; wing usually over 2.50. **P. atricapillus** Linn. **309**

Subgenus LOPHOPHANES Kaup.

308. (731). Parus bicolor LINN.*Tufted Titmouse.**

SYNONYMS, PETER-PETER, SUGAR BIRD.

Adult.—Conspicuously crested; above, ashy; forehead, black; below, whitish; sides, brownish.

Length, 5.65-6.50; wing, 3.05-3.45; tail, 2.80-3.15.

RANGE.—Eastern United States north to Connecticut Valley and southern Michigan; west to central Texas and Nebraska.

Nest, in Woodpecker's hole, or natural cavity in stump or tree, 2 to 60 feet from ground, generally 5 to 30 feet; of leaves, bark, moss, hair, feathers, and sometimes snake skin; loosely constructed. *Eggs*, 5-6, sometimes as many as 9; white or creamy-white, speckled and spotted, often heaviest near larger end, with hazel, rufous, chestnut or vinaceous, and sometimes lilac; .71 by .54.

An abundant resident in southern Indiana and north, at least in the Wabash Valley, to Parke, Warren, Carroll, Tippecanoe and Wabash counties. Northward, in many localities, it is rare, and about the southern end of Lake Michigan it is apparently wanting. Mr. J. G. Parker, Jr., informs me it is not uncommon at Kouts, Ind., 60 miles southeast of Chicago, Ill., where he took a specimen, November 23, 1894, and a pair, December 10, 1896.

In the northern part of the State and in Michigan it is irregular in its occurrence. Some places it appears occasionally as a straggler in fall, winter or spring; other places, it is a summer resident, disappearing in the fall and returning in the spring. In other localities it is present, some years, the year round, and others only in summer. It, however, through our northern counties, seems to be increasing in numbers, and in some places, where it was only seen occasionally certain seasons, has become a permanent part of their bird life. Prior to 1890, the only record I had from Starke County was from Mr. H. K. Coale, who found a pair there, January 1, 1884. At English Lake,

however, since 1890, Mr. Deane has met with them a number of times at almost all seasons, and it would seem to be resident. In 1887, Mrs. Jane L. Hine informed me it was very rare in Dekalb County, and had only been observed in autumn. They continued so until the winter of 1890-91, when they began to increase. Some winters they remained and others they disappeared. It is now tolerably common there, and breeds. It also breeds in Elkhart County, where a nest was taken, June 12, 1891, containing seven young birds (McBride, Proc. I. A. S., 1891, p. 167). It was very common near Peru in October, 1893, where it is probably a resident (Dunn). Mr. Elwood Pleas informs me that it is a tolerably common resident at Dunreith,



Head of Tufted Titmouse. Natural size.

Henry County. April 14, 1894, he found one impaled on a thorn—evidently the work of a Shrike. It is also a rather abundant resident at Richmond, where it breeds (Dr. E. Test, A. M. Hadley). Mr. G. G. Williamson reports it from Muncie, November 22, 1896. Mr. V. H. Barnett says it is common and breeds in Vermillion and Warren counties. Dr. A. W. Brayton, of Indianapolis, has a beautiful albino of this species.

The Tufted Titmouse frequents all kinds of woodland. In summer, it prefers the quiet of the denser forest or of the trees along the river bottoms. In winter they go wherever their companions go, or, rather, they lead the company where they will. Through woods, thickets, tangled ravines, along the old worm fence, into the orchard, then among the garden shrubbery. Their loud whistle sounds *peto, peto, peto, peto*, and when one comes upon them to see what is the matter, the Downy Woodpecker calls *quit, quit*. This Titmouse utters *de-de-de-de*, and thus reminds one by his call of his relationship to the Chickadees. The warm, sugar-making days of early spring, they proclaim

their happiness throughout all the woods, and the sugar-makers know them then as "Sugar Birds." I have observed them mating as early as April 8 (1887), and have found them nest-building May 16 (1884). The nest is usually in a hole in a tree, snag, fencestake or post. Messrs. Dury and Freeman found an unusual nest, May 25, 1878, near Cincinnati, O. A Tufted Titmouse selected as its breeding place the discarded nest of some large bird, in the top of a tall sapling. The bird had deposited six eggs (nearly hatched when found) on a layer of dry grass, which nicely lined a large hole which she had excavated in the side of the rough structure (Journ. Cin. Soc. N. H., 1879). The Tufted Titmouse is not only a hunter of insects over the trunks and among the limbs of trees, but it examines the ground and explores the rank shrubbery. It also visits the orchards, and sometimes makes its home there. There it is very busy about the blossoms, leaves and fruit, not only gathering insects for itself, but also to supply the wants of its young.

Subgenus *PARUS* Linnaeus.

***309. (735). *Parus atricapillus* LINN.**

Chickadee.

Synonym, BLACK-CAPPED CHICKADEE.

Adult.—Above, plain grayish; crown and throat, deep black; greater wing coverts, distinctly edged with whitish; sides of head and neck, and other lower parts, white, the latter buffy on the sides; tail and wing, usually about equal in length.

Length, 4.70-5.75; wing, 2.50-2.75; tail, 2.50-2.75.

RANGE.—Northeastern North America, from North Carolina (in Alleghany Mountains), Missouri, southern Illinois, northern Indiana and Virginia to Labrador and Ontario. Breeds almost to the southern limit of its range.

Nest and Eggs, similar to those of *P. carolinensis*.

Abundant resident in the northern part of the State; common winter resident for a little distance south of the area where it is a resident. Not often seen in the southern part of the State, and then only as a winter visitor. In the absence of a series of specimens it is impossible to define the limits of the range of this species southward, or of the next bird northward. However, to most persons, they appear to be the same bird; and, as their habits are practically the same, the only ones who will regret this lack of detail will be the naturalists. This Chickadee is a common resident in Lake County (Parker); Dekalb County (Mrs. Hine); Tippecanoe County (Test); Starke County

(Coale, Deane); Wayne County (Hadley). In Carroll County, it is the most common form (Evermann). In Wabash County, it is an abundant winter resident (Ulrey and Wallace); and in Monroe County it has also been noted in winter (Evermann, Blatchley). I have never taken it in Franklin County.

The note of this species is lower and more slowly given than that of *Carolinensis*. It consists of three notes, which sound like *chick-a-dee*, or as others say, *te-derry*. At other times they call *day, day, day*.



Chickadee.

Twelve specimens examined by Prof. King had eaten 14 larvæ (10 of which were caterpillars), 13 beetles, 2 spiders, 5 insect eggs, some other insects, and a few seeds (Geol. of Wis., I., p. 484). They are also very destructive to leaf-rolling caterpillars, tent caterpillars, and other noxious forms also.

Prof. Forbes found those that frequented an orchard infested with canker-worms made 75 per cent. of their food of those insects (Rept. Mich. Hort. Soc., 1881, p. 204).

***310. (736). *Parus carolinensis* AUD.**

Carolina Chickadee.

Adult.—Similar to *P. atricapillus*, but tail decidedly shorter than wing; greater wing coverts, *not* distinctly edged with whitish.

Length, 4.25-4.60; wing, 2.40-2.60; tail, 2.10-2.50.

RANGE.—Southern United States, north to New Jersey and central Indiana; west to Texas and Indian Territory. Resident throughout its range.

Nest, in cavity in tree, stump, post or rail, usually not over 10 feet up; of grass, bark shreds, feathers and hair. *Eggs*, 5-8; white, speckled with light reddish-brown, markings heaviest at larger end; .57 by .45.

The Carolina Chickadee is an abundant resident throughout southern Indiana, where it replaces the last mentioned form. This bird extends, at least in the Wabash Valley, two-thirds of the way across the State. In Carroll County, both forms are found resident, but this is least common. Doubtless they occasionally are found north to our northern limit. Mr. J. G. Parker, Jr., informs me he has a specimen taken at Lake Forest, Ill., December 12, 1890.

The Chickadee proclaims itself by its note, *chicka-dee-dee*, which is louder than that of the Blackcap. They also have a call—*day, day*—very similar to the last species, and a two-note utterance that sounds something like *hey-de, hey-de*.

I have seen them mating, March 31 (1884), and full sets of eggs are sometimes found late in April and early in May. The following description of a nest taken at Richmond, Ind., May 12, 1889, by Mr. H. N. McCoy, from a hole six inches deep in a fence rail lying against a fence, is characteristic both as to nest and location in localities where worm fences are commonly found. Nest: outside diameter, 3¼ inches; inside diameter, 2 inches; depth, 1¾ inches; lower part, green moss; upper part, vines, bark, cowhair and a little wool, all woven together closely. Contained 6 fresh eggs. Another favorite nesting place is in a dead willow stub, along a stream. In those and the dead trunks of other soft-wood trees they can readily excavate a nest. A hole made by a Downy Woodpecker is often handy, and they promptly occupy it. In winter they use excavations made by themselves and other birds as protected quarters, and there keep snug and dry, though, with the weather below zero and no fire, we may express our sorrow for the poor little mite. On the morrow, however, he is still able to sing his merry song. Their food is similar to that of the last mentioned species. Often they may be seen clinging to the blossom end of a large apple, inspecting it for larvæ, and when they are found, drawing them forth. It likes the worm, and, if it gets it, is willing to leave to the farmer the apple.

LI. FAMILY SYLVIIDÆ. KINGLETS AND GNATCATCHERS.

- α^1 . Front of tarsus with transverse scales at extreme lower portion only; wings longer than tail; tail without white; nostrils concealed by small feathers.

Subfamily REGULINÆ. REGULUS. 174

- α^2 . Front of tarsus covered with transverse four-sided scales; wings not longer than tail; tail more or less white.

Subfamily POLIOPTILINÆ. POLIOPTILA 175

SUBFAMILY REGULINÆ. KINGLETS

174. GENUS REGULUS CUVIER

- α^1 . Nostril hidden by a single small feather; crown with a black stripe on each side. Subgenus REGULUS. **R. satrapa** Licht. 311

- α^2 . Nostril with a tuft of small bristle-like feathers; crown without black stripes. Subgenus PHYLLOBASILEUS Cabanis. **R. calendula** Linn. 312

311. (748). **Regulus satrapa.** LIGHT.**Golden-crowned Kinglet.**

Adult Male.—Above, olive-green; brighter on rump and wings; crown, yellow, with an orange center and a black stripe on each side; forehead and stripe over eye, whitish; beneath, dull whitish. *Adult Female*.—Similar, but lacking the orange center in the yellow crown.

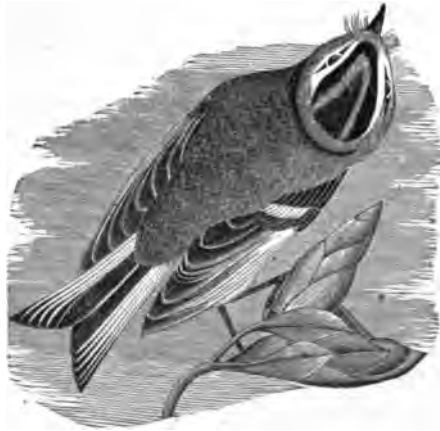
Length, 3.15-4.55; wing, 2.10-2.25; tail, 1.60-2.00.

RANGE.—North America, from Mexico (State of Vera Cruz) north, at least to Labrador. Breeds from North Carolina, in Alleghany Mountains, and Massachusetts, north; also south along the Rocky Mountains into Mexico. Winters from Indiana, Illinois and Massachusetts, south.

Nest, in evergreen, 6 to 60 feet up; of mosses and lichens, lined with bark fibres, fine rootlets and feathers. *Eggs*, 9; creamy-white or cream, sprinkled with numerous markings of wood-brown and occasionally a few of lavender; .55 by .44. (Brewster).

The Golden-crowned Kinglet is an abundant migrant in early spring and late fall. Over the southern half of the State, at least, they are irregularly rare winter residents. They begin to arrive about the southern end of Lake Michigan sometimes as early as September 17, and the first arrivals are found in the southern part of the State such a season by October 8. The year 1896 was one of early fall migration. That year they arrived at Chicago, September 17; at Bicknell, October 8; and Greensburg, October 9. Prof. E. L. Moseley informs me that thousands of Creepers and Kinglets must have been in Sandusky, O., October 2, 1896, the first pleasant morning after a long nocturnal storm.

They usually pass south through October, though sometimes they remain in our northern counties well into November, and perhaps, favorable seasons, all winter. They were noted at Chicago, Ill., November 1, 1896 (Bollman), November 28, 1883 (Parker); Sedan, Ind., November 5, 1894 (Hine); Lafayette, November 21, 1895, where they probably winter (Test). Prof. Evermann thinks it probable a few remain all winter in Carroll County. They are reported as winter residents from Brookville; Bicknell (Chansler); Greensburg (Shannon); Bloomington (Evermann, Blatchley); and Wabash County (Ulrey and Wallace). Prof. Cook reports it as occasional, in winter, in Michigan (B. of M., p. 148).



Golden-crowned Kinglet.

The migrants usually begin their return journey in March, and are very numerous the latter part of that month. They may be found any place, often associated with Brown Creepers and more rarely with one of those social groups of Titmice, Chickadees, Downy Woodpeckers and other companionable birds. The bushes beside a stream are as attractive as the thickets along a deep ravine; the evergreens about our homes, even in towns, are visited as well as the native growth of red cedar; the garden shrubbery and trees in the orchard are sometimes their feeding ground, but not so often as the brush piles and more numerous trees of the dense woods. At all times they have a little tinkling note, but as April comes on, their song begins. Mr. H. K. Coale has interpreted it as "*te-tze-tze-tze*." This is much elaborated when they reach their breeding grounds. It is very similar to that of the Brown Creeper. Sometimes they appear in the greatest abundance. April 12, 1897, I found both these little birds and Brown

Creepers in such numbers as I never saw before. They were everywhere—in woods, thickets, orchards and dooryards—and all in full song.

Spring migrants were noted at Greensburg, March 21, 1894; Richmond, March 26, 1897; Laporte, March 23, 1893; Chicago, Ill., March 23, 1894. Usually they reach northern Indiana about April 1, and leave between the middle and last of the month. The latest spring records at hand are: Brookville, April 24, 1884; Greensburg, April 24, 1895; Richmond, April 27, 1897; Lafayette, April 29, 1893; Chicago, Ill., May 5, 1894, and Miss H. E. Colfax observed it in Porter County, June 8, 1884. Their food is entirely insects. Many of these it takes on the fly, and others are obtained about the trunks and limbs of trees. They are full of energy, which is utilized from dawn till dark. They put in full time and are all the time doing useful work. "Of 9 specimens examined, 2 had eaten 12 small *diptera* (flies etc.); 3, 9 small beetles; 1, 5 caterpillars; 1, a small chrysalid; and 3, very small insects, too fine to be identified" (King, Geol. of Wis., I., p. 482).

312. (749). *Regulus calendula* (LINN.).

Ruby-crowned Kinglet.

Adult Male.—Above, olive-green, brighter on the rump; crown, with a patch of vermillion-red in the center; no black stripes on each side; below, dull whitish. *Adult Female*.—Similar, but with crown patch smaller or wanting. *Immature*.—Similar, but with no crown patch.

Length, 3.75-4.60; wing, 2.20-2.30; tail, 1.85-1.90.

RANGE.—North America, from Mexico (Valley of Mexico) north to the limit of trees within the Arctic Circle. Breeds from Colorado, in the higher mountains, and Oregon, northern Michigan and Quebec, northward. Winters from southern Illinois, South Carolina and Texas, south.

Nest, in evergreen, 10 to 20 feet up, semi-pensile, quite bulky; of bark, moss, weed fibres, spider webs, lined with feathers. *Eggs*, 8; dirty cream-color, darker sometimes, faintly spotted at the larger end; .55 by .43.

The Ruby-crowned Kinglet is a common migrant, as a rule, arriving and remaining later than the last species in the spring and arriving and departing earlier than in the fall. However, in the fall, they occur together, and more frequently associated than in the spring, and the difference in time is not so much noted. In the southern part of the State they are very rare winter residents. They have been noted, in winter, in Monroe County by Profs. Evermann and Blatchley. This

Kinglet is less hardy than the other species and winters farther south. Sumichrast mentions specimens in the collection of Sr. Botteri, from Orizaba, Mexico (*La Naturaleza* Tomo, V., p. 241), and I have found them in numbers in the Valley of Mexico. They begin to return to southern Indiana, May 30, and reach the extreme north of the State some years by April 11. They are most numerous the latter part of that month, when the bulk passes northward.

Some, however, are usually seen after May 1. These are mostly in immature plumage. I always associate them in my mind with the blooming of the apple trees, about which they are often seen. The following are some early and late records, showing the extremes of the period of spring migration: Greensburg, March 31, 1895; May 6, 1893; Brookville, April 6, 1883, May 9, 1885; Spearsville, April 3, 1895, April 26, 1894; Richmond, April 12, 1897, May 1, 1897; Lafayette, April 1, 1893, May 9, 1894; Sedan, April 11, 1889, May 4, 1889, and 1894; Laporte, April 11, 1896; Chicago, Ill., April 13, 1896, May 12, 1895; Petersburg, Mich., April 14, 1897, May 15, 1888.

Miss H. E. Colfax reports it from Michigan City at the unusually late date, June 8, 1884.

When with us they have, like the Ruby-crown, a squeaky note—*ti*—often coupled, two or three together. When many are in company, and not too close to the listener, there is a peculiar tinkling effect. At the latter part of their spring visit they occasionally favor a strolling bird-lover with their love song. Of this song, which few have heard, and known the author, Audubon said: "When I tell you that its song is fully as sonorous as that of the Canary bird, and much richer, I do not come up to the truth, for it is not only as powerful and clear, but much more varied and pleasing."

Their habits, in general, resemble those of the Golden-crowned Kinglet at the same season, except they seem to keep in little companies more to themselves, and are not so frequently associated with the other birds; and they frequent more often the higher limbs of trees, often being seen, a tiny mite, about the topmost boughs of some tall forest tree. This species is not so numerous as the former one, and appears to be more numerous in fall than spring. They occasionally arrive in autumn as early as the beginning of September. Usually, however, they are most numerous the latter part of that month and in October. At Chicago, Ill., they were noted, September 3, 1895, and last fall date is October 20, 1894; Lake County, Ind., September 11, 1881, September 25, 1875; Sedan, September 25, 1894, October 11, 1894; Lafayette, October 26, 1895; Brookville, October 8, 1885, November 11, 1894.

The orchards, shade trees, small fruit farms and woods are visited by these Kinglets, too, and they do much to decrease the number of the insect population there. "Of 7 specimens examined, 2 had eaten 4 small caterpillars; 3, 5 beetles; 1, an ant; 1, a chalcis fly; and 2 bits of insects not identified (King, Geol. of Wis., I., p. 482). It has been said they ate the blossoms of maple, pear, apple and other fruit trees. Recent investigations have shown no evidence of this. It is probable they were observed when they were engaged, as they often are, catching insects about the blossoms, and were wrongly judged and then misrepresented. Mr. E. R. Quick has published the following interesting note concerning it:

"On October 16, 1879, a Ruby-crowned Wren took up its abode in a barroom, in Brookville, where it remained until the 25th, flying about amongst the often noisy patrons of the establishment; and, though it ~~was~~ caught and handled, to thoroughly identify it, this summary proceeding did not cause it to leave, although the door stood open during the entire day. During its stay it subsisted on flies, which it very expertly captured, returning to its perch to eat them in the manner of the flycatchers. Toward the latter part of its sojourn it became so much accustomed to its strange quarters as to sally out from its perch by lamplight after insects attracted by the light. It finally took its departure without apparent cause, probably to resume its southward migration" (Journ. Cin. Soc. N. H., July, 1880, pp. 121, 122).

SUBFAMILY POLIOPTILINÆ. GNATCATCHERS.

175. GENUS POLIOPTILA SCLATER.

*313. (751). *Polioptila cærulea* (LINN.).

Blue-gray Gnatcatcher.

Adult Male.—Above, blue-gray, bluer on the head, lighter on the rump; forehead and line over the eye, black; ring around the eye, whitish; below, whitish; tail, black, three outer feathers with white. *Adult Female*.—Similar, but lacking black streak across forehead and over the eye.

Length, 4.05-5.50; wing, 2.00-2.20; tail, 2.05-2.20.

RANGE.—Eastern North America, from Guatemala and West Indies to New York, Ontario, southern Michigan, northern Illinois. Accidental to Maine and Minnesota, west to Nebraska and western Texas. Breeds from Gulf coast, north. Winters from Florida, south.

Nest, in woods, 10 to 50 feet up, in fork or saddled on horizontal limb of tree; of moss, fibre or spiders' webs, covered with lichens;

lined with vegetable down, feathers and fine grass; deep. *Eggs*, 4-5; greenish or bluish-white, spotted and marked with different shades of brown; .57 by .44.

The Blue-gray Gnatcatcher is a summer resident; very abundant southward, and in some localities is rare or wanting. They are very irregular in their migrations. Some years they appear in southern Indiana late in March, and others, not until a month later. Some seasons, in one locality, they appear very early, and in others, quite late; 1893 and 1896 were years of early migration in southern Indiana,



Blue-gray Gnatcatcher. Natural size.

and 1897 was a medium season. At Greencastle they only arrived one other year as late as they did in 1896, and the earliest is in 1897, which is also the earliest record for the State for that year. It would seem they present an instance of migration *per saltum*; indeed, it is probable that all migration is by leaps, the later comers passing ahead and becoming the van, and then, in turn, being passed by the others; and that here we have a good illustration of it. Early and late dates of first appearance at Greensburg are, March 27, 1896, April 15, 1894; Bicknell, March 28, 1897, April 10, 1894; Brookville, March 31, 1884, April 29, 1895; Greencastle, April 6, 1893, April 20, 1895, 1896; Lafayette, April 4, 1897, April 29, 1893; Sedan, April 16, 1896, May 1, 1894; Chicago, Ill., April 15, 1896, May 4, 1894, 1895; Petersburg, Mich., April 20, 1889, May 5, 1897. They are common, at least, north to Richmond (A. M. Hadley), Anderson (C. P. Smith), Wabash (W. O. Wallace), Tippecanoe (L. A. and C. D. Test), and in Vermillion

County (V. H. Barnett). In Carroll County they are rather common (B. W. Evermann); at Waterloo it is common (F. P. Feagler); Sedan, tolerably common (Mrs. J. L. Hine). It is rare in Allen County (C. A. Stockbridge), and has been reported from Starke County, and breeds (G. Fream Morcom, H. K. Coale); Porter, summer resident (J. W. Byrkit); Lake, breeds (G. F. Clingman). In Cooke County, Ill., it is not common and breeds (C. A. Tallman, Elliot Blackwelder). It is common at Hillsdale, Mich. (C. L. Cass), and tolerably common at Petersburg (Jerome Trombley). I found them at Brookville, paired, April 4, 1884, and they are usually mated when they arrive. April 18, 1882, four days after arrival, they were building. The earliest completed nest I have seen was April 21, 1883, seven days after they were first seen. A set of eggs was noted, May 10, 1881. I have found young as late as July 9 (1886). Mr. E. R. Quick has found, at Brookville, June 4, two well-incubated eggs in a nest which he thinks was begun May 21 (Langdon, Cat. Birds, Vic. Cin., 1877, p. 2). Prof. B. W. Evermann obtained full sets of eggs, May 17, from two nests which were commenced May 5. He thinks they were completed and the first egg laid May 12 (The Auk, January, 1889, p. 29). The nest is one of the most beautiful pieces of bird architecture to be found with us. It resembles the nest of the Ruby-throated Humming-bird, but is much larger. Indeed, it seems from the outside too large for the size of the bird, but the cavity is comparatively small, and in order to sit within it the bird has to erect her head and tail—apparently a very uncomfortable position. The nest is composed of fine fibres and spider webs, and the outside is covered with lichens. It is placed in the fork or saddled upon a limb of a rough-barked tree in the more open woods. When completed, owing to its resemblance to a lichen-covered knot, it is hard to find. While the birds are building it—for both share in the work—they are very industrious and often pay little attention to a visitor. At other times they spy him when afar off, and, like the Tufted Titmouse, continue noisily to pay him attention while he is in the vicinity. The female is the chief architect. Every little while during the course of the construction, she settles herself into the nest and, pressing her breast against the inside wall, stretches her neck over the side, reaching with her bill as far towards the base as possible, and presses it together and works it into shape. Often she works half way around the nest, apparently with much effort and taking great pains. She uses her bill in forming the nest as a potter uses his fingers in shaping the plastic clay. Nests are usually placed 25 to 60 feet from the ground.

The ordinary note is something like *tszee-tszee-tszee*, with occasional squeaks and clucks. Their call has been compared to the Catbird's note and their low, harmonious song—the love song—which is a pleasant surprise to one who hears it for the first time, to a minature of the Catbirds' well-known production.

The song, Dr. A. Le Moyne gives as: “*Twing-twing-twing-twing, ree-ree-ree-ree*,” first half rising scale, latter descending, followed by the low jumble of warbles, which defies any representation.”

They become quiet in July, and after that do not attract so much attention. The following month most of them leave, a few lingering until after the beginning of September. It has been last noted at Brookville, September 6, 1896; in Vermillion County, September 6, 1897; Hillsdale, Mich., September 9, 1894; Chicago, Ill., August 31, 1895.

They are restless, active little birds, which we see first when they come and last before they leave, among the thickets of the more open woodland. Soon after their arrival they are to be seen among the trees, and their peculiar notes, lack of shyness, incessant activity and long tail with outer white tail feathers, are all marks that attract attention.

The one who named this little fidget named it well. Its life is spent in catching small insects, mostly on the fly. In the course of its journey through the woods it seems to be half the time in the air. It keeps its eye upon the intruder, but is determined that he shall obtain a good idea of its expertness in catching gnats and of its ability to gracefully handle its long tail. It performs remarkable gyrations, and accompanies them with the opening and folding of its long tail. Every dart it makes for an insect is followed by a snap of the bill that is the announcement of the end of one small life, and bears to the ears of the observer an emphatic attestation of the bird's ability.

LII FAMILY TURDIDÆ. THRU-HES. SOLITAIRES, SIONECHATS, BLUEBIRDS, ETC

α^1 . Wings and tail with no blue; wing less than four times as long as tarsus.

b^1 . Tail without white at base.

c^1 . Tail less than three times as long as tarsus; breast spotted. TURDUS. 176

c^2 . Tail more than three times as long as tarsus; breast in adult not spotted.

MERULA. 177

b^2 . Tail with basal portion white; plumage entirely without spots in adult.

SAXICOLA.

α^2 . Wing and tail with blue; wing more than five times as long as tarsus.

SIALIA. 178

SUBFAMILY TURDINÆ. THRUSHER.

176. GENUS *TURDUS* LINNÆUS.

- α¹. Color brown above.
 *b*¹. Tail brighter than back. *T. aonalaschkæ pallasii* (Cab.). 319
 *b*². Tail not brighter than back.
 *c*¹. Sides spotted; head, in adult, brighter than back. *T. mustelinus* Gmel. 314
 *c*². Sides not spotted; color uniform above.
 *d*¹. Above light tawny brown; throat spots not darker than back. *T. fuscescens* Steph. 315
 *d*². Above russet olive; throat spots darker than back. *T. fuscescens salicicola* Ridgw. 316
 α². Color above olive.
 *e*¹. Ring around the eye and sides of head and breast buffy. *T. ustulatus swainsonii* (Cab.). 318
 *e*². No buffy ring around eye; sides of head grayish; breast lighter; throat white. *T. alicie* Baird. 317

Subgenus *HYLOCICHLA* Baird.*314. (755) *Turdus mustelinus* Gmel.

Wood Thrush.



Head of Wood Thrush. Natural size.

Adult.—Above, cinnamon-brown, brighter and more rufous on the crown, more olive on the tail; beneath, including the sides, white, the breast and sides marked with roundish spots of black. *Immature*.—With the upper parts spotted and streaked with yellowish fulvous.

Length, 7.50-8.25; wing, 4.10-4.50; tail, 3.00-3.30 (Ridgway).

RANGE.—North America, from Honduras and Bermudas over the eastern United States to Maine, Quebec and Minnesota; west to Kansas and North Dakota. Breeds from Georgia and southern Missouri north. Winters from Texas and Florida south.

Nest, on horizontal branch or fork of low tree or sapling, 6 to 15 feet up; of mud, leaves, weeds and twigs, lined with fine rootlets.

Eggs, 2-5; greenish-blue; 1.00 by .75.

The Wood Thrush is a common summer resident. Throughout the denser woodland its ringing metallic notes may be commonly heard from its arrival in spring until July and occasionally into August. Its well-known call, *e-o-lie*, is one of the features of our forests that is passing with the clearing of the land. The flourishing of the magic ax has wrought greater changes than seemed possible to our childish mind by the wave of a fairy's wand. I recall deep woods, from which comes the notes *e-o-lie*, that have disappeared, and from the fields that mark their site is borne the sound of the rattle of the mower, the tinkle of the sheep bell, or the song of the Dickcissel. The song of the Wood Thrush is one of the most beautiful in the forest.

They usually appear in southern Indiana after the middle of April and are common before May 1. Towards our northern boundary they arrive one year with another near May 1, and are common from the 10th to the 15th of that month. The year 1897 gives us a remarkably early record—about two weeks earlier than they ever were reported. At Edwards, Vigo County (A. H. Kendrick), they were noted April 3; at Brookville, April 5. It was noted at Hillsdale, Mich., April 8, 1884 (C. L. Cass). Hitherto, the earliest record at Brookville and in the State was April 15, 1887, and the latest first arrival, May 3, 1882. They have first been noted at Bicknell, April 21, 1897, April 23, 1895; Lafayette, April 23, 1897, April 29, 1893; Sedan, April 28, 1896, May 3, 1895; Laporte, May 1, 1894, 1896; Petersburg, Mich., April 27, 1888, May 5, 1897; Chicago, Ill., April 28, 1896, May 11, 1895. At Brookville they have been seen mating April 27 (1894), where I have found them nesting as late as July 8, 1886. Prof. B. W. Evermann found a nest with eggs at Bloomington, May 6, 1886, and in Carroll County found full sets May 24, 1883. The nest is placed in a bush or sapling just beyond my reach, generally from eight to fifteen feet from the ground. Like the Robin, the Wood Thrush uses considerable mud in nest building, and its eggs resemble those of that bird, but are smaller.

They are largely insectivorous. Prof. S. A. Forbes found that 72 per cent. of their food was insects, and the greater part of them ground-inhabiting forms. Twenty per cent. of their food was fruits, much of which they obtain from their haunts. In April and May, during the migrations, insects formed 84 per cent of their food. Ants formed 15 per cent.; diptera, principally craneflies and wire-worms, 12 per cent.; lepidoptera, one-third of them cut-worms, 13 per cent.; beetles, 18 per cent. (Bulletin No. 3, Ill. S. Lab. N. H., pp. 127-129). It is probable with a little encouragement the Wood Thrush could be induced to come into our orchards, fruit gardens and about the

shrubbery of larger farm yards. In fact, it has been noted as so doing in the east (King, Geol. of Wis., I., p. 474). While it would probably demand its toll in fruit, yet it would grind therefore an enormous grist of insects. They begin to leave in August, and often are not seen after the first of September, while other falls they occur after the first of October. The latest record from Brookville is September 7, 1886; Lafayette, September 15, 1894; Sedan, October 15, 1894; Cincinnati, O., October 7, 1877; Warren County, September 20, 1897. While some remain on our southern border, others go as far south to winter as Honduras (Biol. Cent. Am. Aves., Vol. I., p. 9).

***315. (756). *Turdus fuscescens* STEPH.**

Wilson's Thrush.

Synonym, VEERY.

Adult.—Above, uniform light tawny-brown; below, white; breast, buffy, it and sides of throat marked with wedge-shaped spots of about the same color as the back, often arranged in more or less regular rows; sides of belly slightly grayish.

Length, 6.45-7.75; wing, 3.75-4.15; tail, 2.70-3.30.

RANGE.—America, from Brazil over eastern United States to Newfoundland and Manitoba. Breeds from North Carolina along the Alleghanies, Pennsylvania and Indiana northward. Winters from Florida southward.

Nest, on ground or near it, loosely constructed of dry leaves, bark shreds, grass and weeds; no mud. *Eggs*, 3-5; grayish-blue; rarely marked; .85 by .67.

Wilson's Thrush is chiefly a rare migrant, but occurs occasionally as a summer resident and breeds. Some places common. In Franklin County it is one of the rarest birds. But two specimens have been taken in twenty years; in Carroll and Monroe counties it is not very common, and from many localities where there are active collectors it has never been reported. Dr. F. W. Langdon gives it as "a rare migrant in April in the vicinity of Cincinnati". (Jour. Cin. Soc. Nat. Hist., January, 1879, p. 169).

It is usually found late in April and early May, but has appeared as early as April 9 and remained southward until late in May. Mr. Robert Ridgway informs me it breeds in Knox and Gibson counties, and in Dekalb County Mrs. Jane L. Hine said "it will average tolerably common. Abundant in a very few localities, as about the bush and willow-grown bottom land of Stony Lake." In 1897 she informs me they are becoming rare. It possibly breeds in other localities

throughout the State. Mr. Ridgway noted their arrival in **Knox** County, April 21, 1881, and they were observed toward the last of May (Bulletin N. O. C., I., January, 1882, p. 19). Mr. W. O. Wallace noted their arrival at Wabash, April 27, 1894, where they were still found in June. The earliest record from the State is that noted by Prof. B. W. Evermann from Carroll County, April 9, 1885 (The Auk, January, 1889, p. 29). The following additional dates of first arrivals are given: Brookville, April 28, 1897; Spearsville, April 29, 1894, May 6, 1895; Moore's Hill, May 1, 1893; Bloomington, May 13, 1886; Lafayette, April 29, 1893, April 30, 1892; Richmond, May 7, 1897; Sedan, April 26, 1896; April 28, 1889, 1897; Laporte, May 1, 1894; Chicago, Ill., April 29, 1886; Petersburg, Mich., April 26, 1889, 1897, May 2, 1893.

Of these localities they are reported as common from Richmond, Sedan, Laporte and Petersburg, Mich. Mr. Coale formerly found it a rather common migrant in the vicinity of Chicago, but of late years it seems to be very rare. Mr. J. G. Parker, Jr., thinks it is a rare summer resident there. At its breeding places it has the reputation of being one of the most famous woodland songsters. At times it sings far into the night, and has now the name of "Nightingale." All its notes are said to be "clear, bell-like, resonant, distinct, yet soft and of indescribable sadness." Mr. Ridgway says their song consists of an indescribably delicate, metallic utterance of the syllables, *ta-weel'-ah, ta-weel'-ah, twil'-ah, twil'-ah*, accompanied by a fine trill that renders it truly seductive. While they are with us, as migrants, we do not hear their famous song. Their food is largely insects. Prof. King found that of eight he examined, seven ate 2 ants, 9 beetles and one harvestman, and one ate raspberries, and two, dogwood berries (Geol. of Wis., I., p. 471). They begin passing south in August, and most have gone early in September, but some occasionally linger until October.

The latest record at Sedan is September 7, 1889; at Cincinnati, O., September 1, 1879, and at Lafayette, Ind., they were moderately common October 2, 1894.

316. (756a). *Turdus fuscescens salicicola* (RIDGW.).

Willow Thrush.

Similar to *T. fuscescens*, but above, russet-olive: chest, very pale buff with broader wedge-shaped markings of brown darker than the back.

Length, wing, 3.80-4.25; tail, 2.70-3.30.

RANGE.—America, from Brazil north over interior region, between Utah and Mississippi River to British Columbia. Accidental in Illinois, Indiana and South Carolina.

Nest and eggs, similar to those of last species.

This western form of Wilson's Thrush is of rare or accidental occurrence during the migrations about the lower end of Lake Michigan. Mr. H. K. Coale obtained a specimen at Chicago, Ill., September 16, 1877. It was submitted to Mr. Robert Ridgway, who verified the identification. Mr. J. G. Parker, Jr., informs me that he took a male of this form at Grand Crossing, Ill., April 29, 1886, and two at Liverpool, Ind., May 5, 1894.

317. (757). *Turdus aliciae* BAIRD.

Gray-cheeked Thrush.

Synonym, ALICE'S THRUSH.

Adult.—Above, uniform olive; whitish ring around eye; sides of head nearly uniform grayish; below, white, the throat and upper breast often tinged with bright buff, the sides of the former and all the latter with triangular dark-grown or blackish spots; the sides washed with ashy, sometimes tinged with brownish.

Length, 7.00-7.75; wing, 3.75-4.40; tail, 2.95-3.40.

Note.—This species is slightly larger and more plainly grayer on sides of head than *T. ustalatus swainsonii*.

RANGE.—America, from Columbia over eastern United States to Labrador and Alaska; also eastern Siberia. Breeds from Labrador and Hudson Bay north. Winters in Central America and southward.

Nest, in woods, in low bush, 2 to 7 feet up; of moss, strips of bark, old leaves and grass. *Eggs*, deep green, marked with russet-brown spots; .92 by .67.

The Gray-cheeked Thrush is generally not a common migrant in Indiana.

Some places it is very rare and others it at times is common. In the Whitewater Valley it is very rare. I, myself, have never seen a specimen in Franklin County. Prof. Evermann does not give it from Carroll County, but says it is a common migrant in Monroe County (Hoosier Naturalist, May 1, 1887, p. 145). At Spearsville it is tolerably common, where it has been noted April 14 and 15, 1894, April 3 to 10, 1895, and May 5, 1897 (Barnett); and at Lafayette, not very common (L. A. and C. D. Test). Mr. Robert Ridgway has this to say regarding its occurrence in Knox County in the spring of 1881: "The exact date of the arrival of this species was not noted, but was

somewhere near the 20th of April. During the last week of April and the first three weeks of May it was very common, perhaps more so than any of the other small Thrushes. Specimens were shot May 23, and others were observed as late as the 28th of that month, the date of my departure" (Bulletin Nutt. Orn. Club, January, 1882, p. 19). Prof. B. W. Evermann has found it common in Vigo County. Prof. W. S. Blatchley noted them at Bloomington, May 1, 1886. Mr. Charles Barber notes it as abundant at Laporte, April 10th to 12th, 1892, and Mr. C. E. Aiken informs me that he has found it common in Lake County, May 2, 3 and 4, 1894. Mr. J. G. Parker, Jr., says it is a not uncommon spring and fall migrant near Chicago, Ill. He has noted it between May 13 (1886) and May 20 (1896), and in September. Messrs. L. A. and C. D. Test saw twelve at Lafayette, September 4, 1895, and note it May 12, 1892. Mr. Alden M. Hadley took specimens which are in the collection at Earlham College, at Richmond, September 16 and 19, 1896. Messrs. Dury and Freeman noted them at Cincinnati, O., September 16, 1879, and Dr. F. W. Langdon has observed it in that vicinity "rather common early in October, feeding on the berries of the sour gum" (Journ. Cin. Soc. Nat. Hist., January, 1879, p. 169).

Their habits appear to be substantially the same as the Olive-back's. They frequent the same localities, eat similar food, and are often found together. This species seems to be more solitary, and more retiring in its habits than the other.

Prof. Forbes found that the food of ten specimens of this Thrush shot in May consisted of five per cent. mollusks, chiefly *succinea* and *Helix labyrinthica*; ninety-three per cent., insects, almost half of these being ants, of which each bird ate forty-three per cent. Fifteen per cent. of their food was caterpillars; nine per cent., crane flies; eighteen per cent., *coleoptera*, one-half being *aphodidæ*, and the remainder, wire-worms, curculios and plant beetles. Almost none of its food is beneficial elements (Bulletin No. 3, Ill. State Lab. N. H., p. 130).

318. (758a). *Turdus ustulatus swainsonii* (CAB.).

Olive-backed Thrush.

Synonym, SWAINSON'S THRUSH.

Adult.—Above, uniform olive; ring around eye and light feathers on head, buff; below, throat and upper breast, buff, the sides of the former and all the latter spotted with triangular dark-brown or blackish spots; other lower parts, white, spotted next the breast with ashy and washed on the sides with ashy, sometimes tinged with brownish.

Length, 6.35-7.55; wing, 3.80-4.10; tail, 2.80-3.10.

RANGE.—America, from Brazil and Ecuador over eastern North America (west to Great Basin) to Labrador and Alaska. Breeds from Pennsylvania, in the Alleghanies, southern Sierra Nevadas, mountains of southern New England and Manitoba northward.

Nest, in woods in bush, small tree or hollow stump, 5 feet up; of rootlets, bark, grass, moss, lined with finer material. **Eggs,** 3-5; pale blue, spotted chiefly at larger end with reddish-brown, sometimes forming wreath about larger end; .93 by .70.

The Olive-backed Thrush is a common migrant. It is possible it breeds rarely in the extreme northern portion of the State.

Dr. A. W. Brayton says it is a rare summer resident in the north of the State (Ind. Birds, 1879, p. 95).

Some springs they arrive in southern Indiana by April 23 and reach the northern part of the State by April 28. Usually, however, it is about the first of May when they are seen southward, and a week or ten days later before they reach our northern boundary. Most of them pass through in from one to two weeks after they arrive, but individuals are found along our northern border until near the end of May.

It is well to note that this, the Gray-cheeked and Wilson's Thrushes, are late migrants compared with the Wood Thrush and Hermit Thrush. They have been noted at Brookville, April 26, 1883, May 8, 1882; Richmond, May 23 and 24, 1897; Greensburg, May 1 to May 22, 1894; Spearsville, May 4 to 18, 1895; Wabash, May 1 to 5, 1893; Bloomington, May 9, 1893; Lafayette, May 12, 1892; Laporte, April 10, 1893, 1894, May 1, 1893; Sedan, May 6, 1896, May 16, 1889; Chicago, Ill., the earliest date of arrival is April 28, 1896, and they were noted there May 26, 1897.

The Olive-backed Thrush is found in all kinds of woodland, where either singly or in small groups they spend much time upon the ground, where they obtain their food. When surprised they fly upon the lower branches of a tree or bush, usually getting behind a limb or tree trunk out of view, but sometimes simply turning the back to the intruder and then sitting motionless. Often when frightened from this perch they fly wildly away with a flight almost as erratic as that of Wilson's Snipe.

Prof. Forbes examined eleven of these Thrushes taken at different seasons and found 62 per cent. of their food was insects and 35 per cent. fruits. Of the insects, ants constituted 17 per cent; caterpillars, 12 per cent.; beetles, 18 per cent.; crane flies, 4 per cent. Of the fruit eaten 27 per cent. was wild grapes.

In spring their food is like that of the last-described species. The large number of ants, caterpillars and beetles eaten are especial features. In fall they fed largely upon fruits, which constituted 60 per cent. of their food. These were principally wild cherries, elderberries, blackberries, and wild grapes. These last constituted over half of their food (Bulletin No. 3, Ill. S. Lab. N. H., pp. 131, 135, 136). (See also King's Geol. of Wis., I., pp. 475, 476.)

They appear about our northern boundary the last days of August and early part of September, sometimes all the month, are found over the State. Occasionally they are found after October 1. The latest fall date at Brookville is September 13, 1897; in Warren County, September 25, 1897 (V. K. Barnett); at Sedan they were first noted September 3, 1889, and September 16, 1892, and 1894, and the latest date seen was September 26, 1894. At Cincinnati, O., in 1879, they were first seen September 2, and last, September 21. In 1895 they were first seen at Chicago, Ill., August 29, and were last noted there October 5 (Elliot Blackwelder). In 1896 they were first seen there August 29 and last observed September 30 (C. A. Tallman). They appear to be much more numerous in fall than in spring.

They have a loud and beautiful song that is heard about their summer homes. I have never heard them sing during the migrations, though it is possible the later migrants sometimes do. The song of Alice's and the Olive-backed Thrushes are said to be different. Mr. Bicknell thinks that of the present species "is louder, more spontaneous and lyrical. Almost the first note is the loudest and most liquid, after which the melody becomes rapidly finer, seeming to dissolve upon the air like the spent vibration of a stringed instrument. The song of the Gray-cheeked Thrush commences low and reaches its loudest, and I think its highest, part a little beyond half its continuance. It is, throughout, much fainter and of less favorable delivery than the song of the Olive-backed species" (The Auk, April, 1884, pp. 130. 131).

319. (7596). *Turdus aonalaschkæ pallasii* (CAB.).

Hermit Thrush.

Adult.—Above, olive-brown; upper tail-coverts and tail, rufous; buff ring around the eye; below, whitish; throat and front of breast, buffy; sides, olive-brown or olive-gray; sides of throat with blackish stripes and breast with wedge-shaped, triangular blackish spots.

Length, 6.50-7.65; wing, 3.40-3.90; tail, 2.55-3.15.

RANGE.—Eastern North America, from Gulf Coast to mouth of St.

Lawrence River and Manitoba. Breeds from northern Michigan and southern New York north. Winters from Illinois and Pennsylvania south.

Nest, in swampy or low places in woods, on ground; of old leaves, weeds, bark-strips, rootlets and grass; contains no mud; lined with the finer materials. *Eggs*, 4; greenish-blue, pale; .90 by .66.

The Hermit Thrush is a common migrant. It may possibly rarely winter in the lower Wabash Valley and perhaps rarely breeds. Dr. F. W. Langdon says, upon the authority of Mr. Charles Dury, that its nest and eggs were taken near Cincinnati, O., May 10, 1877 (Journ. Cin. Soc. Nat. Hist., January, 1879, p. 169).

The Hermit Thrush is the first to arrive in the spring and the last to depart in the autumn. The early arrivals and tardy departures, however, are but a few of the many who visit us. The bulk of the species are found with us the last half of April and the first half of October. The earliest and latest spring records at Greensburg are March 28, 1896, April 30, 1895; Brookville, April 12, 1897, May 3, 1889; Richmond, April 11, 1897, May 19, 1897; Greencastle, April 22, 1893, May 8, 1895; Carroll County, March 30, 1884; Wabash, March 26, 1894, April 29, 1894; Lafayette, April 5, 1896, May 3, 1893; Sedan, April 5, 1893, May 6, 1889; Laporte, April 12, 1896, May 4, 1894; Chicago, Ill., April 13, 1897, May 20, 1897; Petersburg, Mich., April 7, 1889, 1893, May 20, 1889. They are found in the more open woodland, along the wooded banks of streams, in the more open second-growth and along bushy ravines. In the northern part of the State they frequent damp woods, groves and scrubby growth and about Chicago vacant lots and grounds containing shrubbery. When surprised they fly upon a low limb of a tree or bush and remain there quietly eying the intruder. If not further alarmed they soon fly to a neighboring brush pile, thicket or the top of a fallen tree and begin anew searching for food. Every now and then one hears their cluck, and even though they are hidden by the tangle of leafless vines and stems, one can imagine they are busy.

The winter home of the Hermit Thrush was partly in the range of the destructive storms of 1895, and great numbers evidently perished. In some places none were seen that spring; in others, they were scarce, while a few stations report the usual number. About Chicago they were rather common (Elliot Blackwelder, C. A. Tallman); at Greencastle the usual numbers were noted (Jesse Earlle); at Spearsville (V. H. Barnett) and Lafayette (L. A. and C. D. Test) none were seen; at Sedan they were very rare, only one being observed (Mrs. Jane L. Hine). At Palmer, Mich., where they breed, Mr. O. B. Warren writes

there was a marvelous decrease in numbers, more noticeable than the absence of the Bluebird. In the depths of the northern forests it finds its voice, lost there the year before, of which we of more southern latitudes know nothing. Neither Audubon nor Wilson seem to have known of its song, but such gifted interpreters as Dr. Coues and Mr. John Burroughs have heard it sing and brought to us their conceptions of its efforts, fresh from the cool north woods, written as with the flowing of inspiration from the point of the pen. In Mr. Burroughs' "Wake Robin," we find these words: "Ever since I entered the woods, even while listening to the lesser songsters or contemplating the silent forms about me, a strain has reached my ears from out of the depths of the forest that to me is the finest sound in nature—the song of the Hermit Thrush.

"I often hear him thus a long way off, sometimes over a quarter of a mile away, when only the stronger and more perfect parts of his music reach me; and through the chorus of Wrens and Warblers I detect this sound, rising pure and serene, as if a spirit from some remote height were slowly chanting a divine accompaniment. This song appeals to the sentiment of the beautiful in me, and suggests a serene religious beatitude as no other sound in nature does. It is, perhaps, more of an evening than a morning hymn, though I hear it at all hours of the day. It is very simple and I can hardly tell the secret of its charm. 'O spherul, spherul!' he seems to say; 'O holy, holy! O clear away, clear away! O clear up, clear up!' interspersed with the finest trills and the most delicate preludes. It is not a proud, gorgeous strain, like the Tanager's or the Grosbeak's; suggests no passion or emotion—nothing personal—but seems to be the voice of that calm, sweet solemnity one attains to in his best moments. It realizes a peace and a deep, solemn joy that only the finest soul may know. A few nights ago I ascended a mountain to see the world by moonlight, and when near the summit, the Hermit commenced his evening hymn a few rods from me. Listening to this strain on the lone mountain, with the full moon just rounded from the horizon, the pomp of your cities and the pride of your civilization seemed trivial and cheap."

The greater part of their food is obtained from the ground. Prof. H. K. King examined nine specimens. One had eaten twenty ants; three, a caterpillar each; two, three grasshoppers; six, six beetles; one, a wire-worm; one had eaten wild grapes, and one berries of the Indian turnip (*Geol. of Wis.*, p. 475). Prof. S. A. Forbes examined twenty-one specimens. Eighty-four per cent. of their food was insects; four per cent. spiders, and twelve per cent. thousand-legs. The most of

the insects consisted of ants, fifteen per cent.; lepidoptera (butterflies, moths, cut-worms, caterpillars, etc.), nineteen per cent.; beetles, thirty per cent.; hemiptera, mostly predaceous, eight per cent.; grasshoppers, eight per cent. (Bulletin No. 3, Ill. State Lab. N. H., pp. 129, 130).

In the fall they begin to be seen in northern Indiana, late in September. While the multitude passes through the early part of October, there are some that remain into November. The earliest and latest dates where they have been observed are at Sedan, September 22, 1889, October 27, 1894; Brookville, October 11, 1887, October 22, 1894; Greensburg, October 22, 1893, October 27, 1894; Carroll County, October 5, 1878; Chicago, Ill., October 6, 1893, November 11, 1895.

The Hermit Thrush may be readily recognized by its bright, tawny tail. It is the only thrush that has the tail brighter than the back.

177. GENUS MERULA LEACH.

***320. (761). *Merula migratoria* (LINN.).**

American Robin.

Synonym, ROBIN.

Adult Male.—Above, head, black; eyelids and a spot in front of the eye, white; wings, black; tail, blackish, the two outer feathers tipped with white; other upper parts, slate-gray; below, throat, breast and sides, deep rufous, or reddish; other lower parts, white, the crissum tinged with dusky; bill, yellow. *Adult Female*.—Similar, but paler and duller. Bill, less yellow. *Immature*.—Back, with black markings; breast, sides and abdomen, pale rufous, thickly spotted with black.

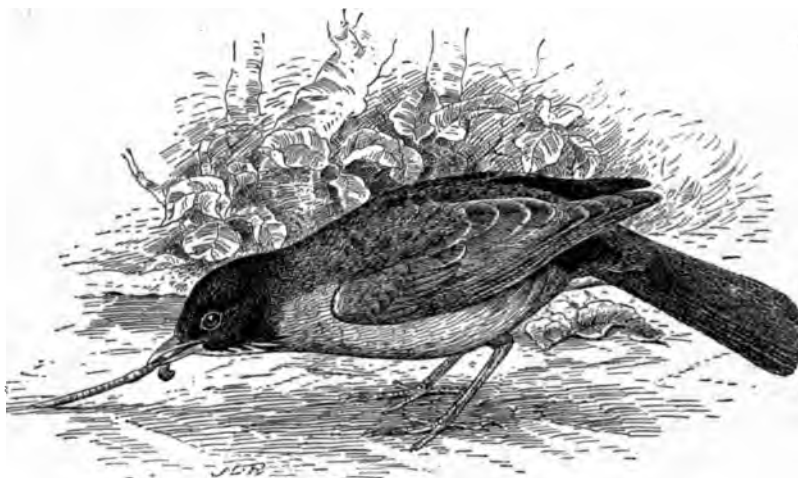
Length, 9.00-10.00; wing, 4.90-5.40; tail, 4.10-4.50.

RANGE.—Eastern North America, from eastern Mexico to Hudson Bay and Alaska, west to Rocky Mountains. Breeds from Virginia and southern Missouri north. Winters from Minnesota, Michigan and southern New England south.

Nest, preferably in fruit tree or shade tree; of twigs, grass, weeds, strings, papers, fibres, with much mud; lined with fine grass. *Eggs*, 4-6; greenish-blue; 1.18 by .81. Two broods.

The Robin is a common summer resident, abundant during the migrations. It is an irregular winter resident throughout the State, more regular and numerous southward. While almost every year they are found the whole year round somewhere in the State, the probability is that the Robins that breed with us are not the ones that winter in the same locality. Usually the migrations begin near the first of February in the vicinity of the Ohio River, and the birds be-

come common that month sometimes within a few days after the migrants are first noted. In the center of the State, in general, they may be looked for near the middle of February, and to become common within the next two weeks. In the northern counties the average arrival is about March 10, a little later in the vicinity of Chicago, and they are common about the 25th of that month. The following are the early and late first appearances of migrants: Brookville, January 17, 1897, February 23, 1885; Greensburg, February 23, 1894; Greencastle, February 11, 1893, March 1, 1896; Lafayette, February 1, 1897, March 23, 1895; Sedan, February 28, 1896, March 18, 1895; Laporte, March 2, 1893, March 16, 1896; Chicago, Ill., March 3,



American Robin.

(Beal.—Farmers' Bulletin 54, United States Department of Agriculture.)

1894, March 27, 1895; Petersburg, Mich., February 26, 1893, March 9, 1897. At Brookville I have found the migrants in flocks in the woods making their way north so late as April 2 (1896), when the local summer residents were nest building. Within the last few years they remained through the winter of 1894-5 in favorable locations over southern Indiana as far north as Greensburg (Shannon) and Greencastle (Earle). The most general distribution of Robins in winter occurred the past winter (1896-7). That year they were found throughout Indiana into northern Illinois and southern Michigan. They were reported from Hanover (Culbertson), on the Ohio River; from Greensburg, where a flock of five hundred was seen December 30, 1896 (Shannon). They were observed at Waterloo (Keep) and Sedan (Mrs. Hine). At Angola they were abundant all winter, feed-

ing upon dogwood berries (Mrs. Sniff). They were common all winter in the vicinity of Chicago, Ill. (Dunn), and at Petersburg, Mich., a flock of a hundred or more were present all winter feeding upon frozen apples (Trombley). At Spearsville, Brown County, and Bicknell, Knox County, they are usually found through the winter.

At the height of the migration they arrive in great flocks, which scatter over the country in little bands through the day and at night collect in favorite roosting places, where several flocks are sometimes associated together. My yard is one of these roosting sites. There they may be found for two or four weeks after arrival every spring. The summer residents usually arrive after the first of March and sometimes not until the latter part of that month. The latest date for their arrival is in 1897, when they arrived March 25. I have heard them begin singing as early as March 8 (1893) and as late as March 23 (1895). The first song is sung from the top of a certain maple tree in my front yard. As the time approaches, I am listening for it, and often while at supper its call sounds, "cheerily, cheer up, cheer up, cheerily, cheerily, cheer up," as Mr. Nehrling would interpret it. He also gives its well-known call as "Durick, tuck, tuck, tuck." They usually begin building early in April, sometimes the first week. Prof. W. P. Shannon notes a pair at Greensburg that began their nest March 28, 1896; first egg laid, April 5; second, April 6; third and last, April 7; began to sit, April 8; hatched, April 21; young left nest, May 3. It requires about seven days to build the nest; an egg is usually laid each day; about thirteen days are required for incubation, and the young remain in the nest twelve or thirteen days. Two broods are reared each year and, doubtless, occasionally, three. The bright color of the breast in spring has darkened by the first of May or before to a dingy reddish-brown. Throughout the late summer the Robins wander over the country, in dry years seeking swampy and other wet places where wild fruits are ripe and ripening. Often about their breeding places they will seem quite scarce. With the last of September flocks of early migrants may be seen, quietly trooping through the woods, making their way southward. This is continued through October and sometimes well into November. They are usually rather quiet, sometimes uttering a loud cry and occasionally voicing a few notes. I heard its well known "*durick*" call November 23, 1896, as strong and clear as it was the preceding spring. Mr. J. G. Parker informs me the migrants sometimes linger in the vicinity of Chicago until November. I have the following late fall dates when they did not winter. Brookville, October 14, 1890; Lafayette, October 21, 1894; Greencastle, December 15, 1893; Sedan,

November 11, 1889. Their remaining through the winter depends not so much upon the weather as upon a supply of food that may be easily obtained.

They gather into large roosts some winters. There was one reported the winter of 1896-7 in Brown County. Considerable attention has been given in different parts of the country to the food of the Robin. I can give but a few points from the conclusions reached. From the time of its first arrival until June, almost its entire food is insects. In the early spring in Illinois, Prof. Forbes found its chief food was the larvæ of a fly (*Bibio albipennis* Say), a species which if allowed to increase might do much damage to meadows and pastures. Mr. Wilcox has found this to be the same in Ohio and doubtless it is true in Indiana. The last named gentleman has found that over 96 per cent. of their food in April, 97 per cent. in May, over 43 per cent. in June, was insects, of which from almost one-fifth to near two-fifths of the total food was injurious species and more than that of neutral species. In June they began eating fruit to an amount equal to 54 per cent. of their food, cherries forming 14.6 per cent. and raspberries 36.6 per cent. Prof. Forbes found, deducting the *Bibio* larvæ, that the total percentage of injurious insects eaten was as follows: February, 18; March, 37; April, 39; May, 55; June, 24; July, 10; August, 31; September, 7, while the percentage of fruits and seeds eaten were for June (when they first became important), 58; July, 79; August, 56; September, 70, and October, 56. In June cherries formed 47 per cent. and raspberries 8; in July, blackberries were 56 and currants 17 per cent.; in August, cherries were 44 and hackberries 5 per cent.; in September grapes were 52 and Mountain Ash berries 8 per cent.; and in October grapes constituted 53 per cent. of their food.

The grapes eaten in October and doubtless many of those eaten in September were wild kinds. In an orchard infested with canker-worms the Robins' food consisted of 40 per cent. of that species (Rept. Mich. Hort. Soc., 1881, p. 204).

Profs. F. and L. Beal have reported an examination of 330 stomachs of Robins taken at different seasons. Forty-two per cent. of their food was found to be animal matter, principally insects, and the remainder is largely small fruits and berries.

From the evidence presented it is safe to say that noxious insects comprise more than one-third of the Robin's food. Vegetable food was found to be nearly 58 per cent. of that eaten, wild fruits forming 47, and varieties that were possibly cultivated a little more than 4 per cent. They ate 25 per cent. of cultivated fruit in June and July. Wild fruit was eaten every month and forty-one kinds were noted.

Small fruits and cherries that ripen early are almost the only fruits that are eaten to any amount. Early cherries are about the only fruit that is ripe at that time when the Robin wants a change of diet. By July and through the remainder of the season there is an abundance of wild kinds that are more to its taste. The investigations show that the Robin takes ten times as much wild as cultivated fruit. The wild plants upon which it feeds are not those gathered by man or adopted by him for cultivation. It is wise either to plant a few extra plants or trees for the birds or to plant a few of some such trees as the Russian mulberry, the fruit of which they seem to prefer to kinds that man values more highly. (On this subject see Farmers' Bulletin, No. 34, U. S. Dept. of Agriculture, pp. 37, 38; Journal Columbus (O.) Hort. Soc., Vol. VI., September, 1891, pp. 75, 80; and Bull. Ill. State Lab. Nat. Hist., No. 3, pp. 89, 107.)

There come years when the severe weather kills some of the Robins. Perhaps this has not been observed to have occurred to so great an extent as it did the latter part of the winter and early spring of 1895. The sudden storms and severe weather of February, March and April south of us covered much of the territory where they winter just as they were beginning to move northward, that they were undoubtedly destroyed in countless numbers. In some localities they seem to have been almost exterminated. The effects of this were noted throughout Indiana, Illinois and Michigan. In the northern part of the first two States, particularly in the vicinity of Chicago, they were very scarce. (See Proc. Ind. Acad. Science, 1895, pp. 165, 166.)

178. GENUS SIALIA SWAINSON.

321. (766). *Sialia sialis* (LINN.).*Bluebird.**

Adult Male.—Above, bright blue; below, throat and breast cinnamon, other under parts white. *Adult Female*.—Above, grayish; wings, tail and rump blue; below, paler. *Immature*.—Similar to female; upper parts and breast marked with white.

Length, 5.70-7.00; wing, 3.90-4.15; tail, 2.60-2.90.

RANGE.—Eastern North America from Cuba, and Bermudas to Nova Scotia, Ontario and Manitoba, west to Rocky Mountains. Breeds throughout its range. Winters from northern Indiana and southern New York southward. Resident in Bermudas.

Nest, in hole in tree, post, stump or in a box; of grass. *Eggs*. 4-6; pale blue, unmarked.

The Bluebird is a common summer resident. It is also resident, being most common southward and varying in numbers different years. The past twenty or twenty-five years the Bluebird has been noticeably becoming less numerous. The persecutions of the English Sparrow and several disastrous winters had almost exterminated them. They are, however, now increasing in numbers. They usually remain through the winter in greater or less numbers as far north as Knox, Monroe and Brown counties and almost to Decatur and Franklin where they are often found at that season. Irregularly they are found over the State. The winter of 1893-4 they were reported at Greencastle and Greensburg; of 1894-5, at Greencastle, Greensburg, Brook-



Bluebird.

(Beal.—Farmer's Bulletin 54, United States Department of Agriculture.)

ville and Oxford, O.; and that of 1896-7, at Hanover, Brookville, Greensburg, and even at Angola, Steuben County. The following are early and late dates of the beginning of migration: Richmond, February 1, 1895, February 24, 1892; Sedan, February 9, 1894, February 27, 1896; Lafayette, February 22, 1892, March 17, 1896; Laporte, February 27, 1894, March 29, 1896; Chicago, March 3, 1894, March 29, 1896. The following dates of the beginning of migration for the spring of 1897 is an average date: Brookville, February 11; Richmond, February 16; Janesville, February 21; Waterloo, February 24; Edwards, Vigo County, February 28; Lafayette, March 7; Liverpool, March 10; Chicago, March 12; Petersburg, Mich., March 6.

I found them paired by February 10, 1882. March 10, 1881, they were nest hunting, and April 11, that year, they were nesting.

Prof. Evermann found a nest with a full set of eggs at Bloomington April 4, 1882, and I noted young at Brookville April 14 of the same year. It rears two and sometimes three broods, often occupying the same site for years.

Occasionally eggs are found that are pure white, but usually the entire set is of the same color. Mr. A. H. Kendrick, of Edwards, Ind., informs me that he has taken a set of six, five of which are white, and one, dark blue.

Prof. B. W. Evermann in the *Ornithologist and Oologist*, August, 1886, p. 124, gives an account of a female Bluebird that laid three successive sets of five white eggs each, the first two sets having been taken. May 5, 1884, the first set was taken. May 14, the second nest was completed and first egg laid. One egg was laid each day and the set was completed the 18th. It was removed May 20th. The next day work began rebuilding the first nest. June 3 the nest was completed and the third set was complete. It was not removed. In thirty days two nests had been built and fifteen eggs laid. After the last brood is reared they wander about the country in little groups, perhaps family parties from three to a dozen individuals. These become more numerous in October and November. With the first severe weather most of them retire for a few weeks a little farther south. The great number of Bluebirds winter between the Ohio River and the Gulf Coast. This region is also the winter home of most of the Robins, Hermit Thrushes, Yellow-rump Warblers and Home Wrens.

Dr. Vernon Gould, of Rochester, writes me that as a boy he recalls having frequently found the bodies of Bluebirds under the loose bark of trees and in crevices and cavities where they had sought shelter-but found death through the severe weather. Many of us recall similar instances of the effect of sudden severe cold spells upon these birds. The peculiar weather conditions of the early part of the year 1895 had a deadly effect upon them. The Bluebirds remained in some numbers north almost to middle Indiana, until late in December, 1894. The weather was warm until after Christmas. December 27 and 28 it became quite cold in this latitude. The Bluebirds were forced farther southward beyond the limits of the severe weather. There it remained warm until late in January. On the 24th of that month the temperature as far south as South Carolina remained near the zero mark. It turned warmer that night and the next day. January 25, the weather was bright and clear. The day following was Friday. It rained, then snowed; the wind came down from the northwest with great velocity and the temperature fell rapidly. Everything was ice-bound or snow-bound to the Gulf of Mexico. Then followed weeks

of unusual severity. By the end of the severe weather in April, it is said, but few Robins or Bluebirds could be found. The destruction of bird life must have been enormous. The Bluebirds seem to have been almost exterminated. Few, indeed, returned to their breeding grounds in the north and from many localities none were reported the spring of 1895. At Vincennes (Bicknell), Frankfort (A. B. Ghen), and Rochester (Gould), Ind., and Oxford, Ohio (Prof. A. L. Treadwell), none were observed.

At the following places very few were seen: At Redkey, probably six or seven (Roy Hathaway), none breeding; Greensburg, few (Prof. W. P. Shannon); Upland, not more than a dozen (D. W. Collet); Hanover, few (Prof. Glenn Culbertson); Greencastle, few (Jesse Earlle); Sedan, very rare (Mrs. Hine); Lafayette, three (L. A. and C. D. Test); Waterloo, very rare, (C. L. Hine); Orange, Martin and Dubois counties, very scarce (E. M. Kindle); English Lake, one seen, very scarce (R. Deane); Wilders, Ind., heard a pair in July, very scarce; none seen about Chicago (J. O. Dunn); Sandusky, Ohio, very scarce (Prof. E. L. Moseley); Agricultural College, Mich., one heard, none seen (Prof. T. L. Hankinson); Brant, Mich., very scarce (Dr. W. DeClarence); Bay City, Mich., one, nearly extinct (Eddy); Grand Haven, Mich., two (E. Davidson); Plymouth, Mich., few, one pair nested (R. C. Alexander); Glen Ellyn, Ill., three seen (B. T. Gault); Morgan Park, Ill., twelve seen, four of them young (Elliott Blackwelder); Chicago, Ill., not over twenty seen the entire year (C. H. Tallman). At Brookville but a few were seen in the spring and none through the summer. In the fall a number were noted. (See Proc. Ind. Acad. Sci., 1895, pp. 162, 165.) There was an increase in number in 1896 and again in 1897.

Indeed through October and November of the latter year they were quite common at Brookville.

The Bluebird is one of the most domestic of birds. It builds its nest in holes in posts, rails, outbuildings, in holes in trees, very often selecting the orchard as its site. It eats almost no fruits or seeds of beneficial plants, and the only thing charged against it is the beneficial insects it takes. Of 205 birds reported upon by Prof. F. E. L. Beal, 76 per cent. of their food was insects and allied forms. The other 24 per cent. was various vegetable substances, mostly eaten in winter. Beetles constituted 28 per cent of the total food; grasshoppers, 22; caterpillars, 11. All are more or less harmful, except a few predaceous beetles, amounting to 8 per cent. The destruction of grasshoppers and caterpillars is very large. The former constitute more than 60 per

cent. of its diet in August and September (Farmers' Bulletin, No. 54, U. S. Dept. Agr.).

Prof. S. A. Forbes found a bird taken in an orchard infested with canker-worms had eaten 60 per cent. of that food. But on the contrary he found that both this and the Thrushes made about 16 per cent. of their food of predaceous beetles which are beneficial, and were making about one-sixth of their food of canker-worms. (Rept. Mich. Hort. Soc., 1881, p. 204; see also Bulletin Ill. State Lab. N. H., No. 3, pp. 137, 148.)

This bird deserves special encouragement and protection.

Nesting places should be provided for it about gardens, orchards, groves and yards. If protected from pestiferous, English Sparrows and wanton boys it will thus have a better opportunity to regain its former numbers and will be more useful where its powers as an insect destroyer are most needed.

HYPOTHETICAL LIST.

The following list of species which have not been, as yet, positively reported from the State, is composed of those forms which have been taken in neighboring States, or whose known range seems to include Indiana. Some of them, it will be noticed, are of very rare or accidental occurrence in the locality where they have been found, and possibly may not be found at all within our limits. For the sake of abbreviation references are made as follows:

RIDGWAY CAT.—Ridgway's Catalogue of the Birds of Illinois, Bulletin No. 4, Illinois State Laboratory of Natural History.

RIDGWAY, ILL. ORN.—Ridgway's Ornithology of Illinois, Vol. I., 1889; Vol. II., 1895.

RIDGWAY MANUAL.—Ridgway's Manual of North American Birds, Philadelphia, J. B. Lippincott Co., 1887; revised edition, 1896.

GIBBS.—Gibbs' Annotated List of the Birds of Michigan, Bulletin of the U. S. Geological and Geographical Survey of the Territories, Vol. V., No. 3.

WHEATON.—Dr. Wheaton's Report on the Birds of Ohio, Geological Survey of Ohio, Zoölogy and Botany, Vol. IV.

BECKHAM.—Beckham's List of the Birds of Nelson County, Kentucky; Kentucky Geological Survey, 1885.

NELSON, N. E. ILL.—Nelson's Birds of Northeastern Illinois, Bull. Essex Institute, Salem, Mass., 1876.

NELSON, S. ILL.—Nelson's Notes upon Birds observed in Southern Illinois, between July 17 and September 4, 1875, Bull. Essex Institute, June, 1877.

COOK, MICH.—Cook's Birds of Michigan, April, 1893.

FAMILY PODICIPIDÆ. GREBES.

GENUS ÆCHMOPHORUS COHEN.

1. (1) *Æchmophorus occidentalis* (LAWR.).

Western Grebe.

I am now satisfied that this species was erroneously placed in my list of 1890.

FAMILY URINATORIDÆ. LOONS.

GENUS URINATOR CUVIER.

2. (9). *Urinator arcticus* (LINN.).

Black-throated Loon.

Rare winter visitor, Lake Michigan. No Illinois record. Ridgway, Ill. Orn., II., pp. 256-7; Ohio, rare visitor (Wheaton, p. 565); Michigan, rare (Gibbs, p. 496).

FAMILY ALCIDÆ. AUKS, MURRES AND PUFFINS.

SUBFAMILY PHALERINÆ. AUKLETS, MURRELETS, GUILLEMOTS.

GENUS SYNTHLIBORAMPHUS BRANDT.

3. (21). *Synthliboramphus antiquus* (GMEL.).

Ancient Murrelet.

Wis., Lake Michigan (Cook, Mich., p. 30).

SUBFAMILY ALLINÆ. DOVEKIES.

GENUS ALLE LINK.

4. (84). *Alle alle* (LINN.).

Dovekie.

Lake Michigan (Cook, Mich., p. 31).

FAMILY STERCORARIIDÆ. SKUAS AND JAEGER.

GENUS STERCORARIUS BRISSON.

5. (37). *Stercorarius parasiticus* (LINN.).

Parasitic Jaeger.

Cleveland, Ohio, Auk, April, 1896, p. 171; Illinois, Bull. Nutt. Orn. Club, Vol. V., p. 31; Lake Michigan, Ridgway, Ill. Orn., II., pp. 216-17.

6. (38). *Stercorarius longicaudus* VIEILL.

Long-tailed Jaeger.

Illinois, Ridgway, Ill. Orn., II., pp. 217-18.

FAMILY LARIDÆ. GULLS AND TERNS.

SUBFAMILY LARINÆ. GULLS.

GENUS *RISSA* STEPHENS.7. (40). *Rissa tridactyla* (LINN.).

Kittiwake Gull.

Illinois and Wisconsin, rare winter visitor (Nelson, N. E. Ill., p. 146; Ridgway, Ill. Orn., II., pp. 221-2); Ohio, rare winter visitor (Wheaton, p. 549); Michigan, rare (Gibbs, p. 495); Illinois (Woodruff, in letter).

GENUS *LARUS* LINNÆUS.8. (47). *Larus marinus* LINN.

Great Black-backed Gull.

Kent County, Mich., March 28, 1889, White. (Cook, Mich., p. 32.) Illinois, winter resident (Nelson, N. E. Ill., p. 145); Ohio, rare winter visitor (Wheaton, p. 547); Michigan, rare (Gibbs, p. 495).

9. (51). *Larus argentatus* BRÜNN.

Herring Gull.

Ridgway (Ill. Orn., Vol. II.) thinks its occurrence doubtful. Illinois, rare winter visitor (Nelson, N. E. Ill., p. 145).

10. (58). *Larus atricilla* LINN.

Laughing Gull.

Washtenaw County, 1 specimen, 1884, Watkins (Cook, Mich.); Illinois, rare summer visitor southward (Ridgway Cat., p. 202); Michigan, abundant (?) (Gibbs, p. 495).

GENUS *XEMA* LEACH.11. (62). *Xema sabinii* (SAB.).

Sabine's Gull.

Illinois, rare winter visitor to Lake Michigan (Ridgway, Ill. Orn., II., pp. 237-8) (Ridgway Cat., p. 202); Ohio, accidental on Lake Erie (Wheaton, p. 552).

SUBFAMILY STERNINÆ. TERNS.

GENUS GELOCHELIDON BREHM.

12. (63). *Gelochelidon nilotica* (HASSELQ.).**Gull-billed Tern.**

Illinois, rare summer visitor (Ridgway Cat., p. 202); Ohio, rare visitor northward (Wheaton, p. 552); Michigan, not rare summer visitor (Gibbs, p. 496). St. Clair Flats, breeds (Cook, Mich.). Breeds, Lake Michigan (Ridgway, Ill. Orn., II., p. 242).

GENUS STERNA LINNÆUS.

Subgenus THALASSEUS Boie.

13. (64). *Sterna tschegrava* LEPECH.**Caspian Tern.**

Illinois, winter visitor (Ridgway Cat., p. 202); Michigan, accidental (Gibbs, p. 495). St. Clair Flats. Breeds, Islands, Lake Michigan (Cook, Mich.); also C. L. Cass, Manuscript. Breeds abundantly on islands in Lake Michigan.

Subgenus ACTOCHELIDON Kaup.

14. (65). *Sterna maxima* BODD.**Royal Tern.**

Illinois and Wisconsin, summer visitor (Ridgway Cat., p. 202); Michigan, rare summer visitor (Gibbs, p. 495; Cook, Mich., p. 34).

15. (71). *Sterna paradisæa* BRÜNN.**Arctic Tern.**

Michigan, not common migrant (Gibbs, p. 496). It has been accredited to Ohio, perhaps by mistake (Wheaton, p. 561). Lake Koshkonong, Wis., breeds (L. Kumlein) (Cook, Mich.).

FAMILY PHALACROCORACIDÆ. CORMORANTS.

GENUS PHALACROCORAX BRISSON.

Subgenus PHALACROCORAX.

16. (119). *Phalacrocorax carbo* (LINN.).**Cormorant.**

Given by Dr. Haymond, but more recently regarded as an error. Also reported from Ohio, but that is now considered an error (Wheaton, p. 545); Michigan (?). Noted as doubtfully an occasional visitor (Gibbs, p. 495).

17. (121). *Phalacrocorax mexicanus* (BRANDT).**Mexican Cormorant.**

Illinois (Bull. Nutt. Orn. Club, Vol. V., p. 31).

FAMILY PELECANIDÆ. PELICANS.**GENUS PELECANUS LINNÆUS.****Subgenus LEPTOPELICANUS Reichenbach.****18. (126). *Pelecanus fuscus* LINN.****Brown Pelican.**

Illinois (Bull. Nutt. Orn. Club, Vol. V., p. 31).

FAMILY ANATIDÆ. DUCKS, GEESE AND SWANS.**SUBFAMILY ANATINÆ. RIVER DUCKS.****GENUS ANAS LINNÆUS.****Subgenus QUERQUEDULA Stephens.****19. (141). *Anas cyanoptera* VIEILL.****Cinnamon Teal.**

Illinois, occasional visitor (Ridgway Cat., p. 199).

GENUS HISTRIONICUS LESSON.**20. (155). *Histrionicus histrionicus* (LINN.).****Harlequin Duck.**

Illinois and Wisconsin, in winter (Nelson, N. E. Ills., p. 142); Ohio, mentioned by error (Wheaton, p. 535); Michigan and Wisconsin (Cook, Mich., p. 44). Ridgway, Ill. Orn., I., pp. 172-3.

GENUS CAMPTOLAIMUS GRAY.**21. (156). *Camptolaimus labradorius* (GMEL.).****Labrador Duck.**

Formerly found in Michigan (Gibbs, p. 494); Great Lakes (Ridgway Manual, p. 107). Now very rare, if not extinct.

GENUS SOMATERIA LEACH.**Subgenus SOMATERIA.****22. (160). *Somateria dresseri* SHARPE.****American Eider.**

Illinois and Wisconsin, in winter (Nelson, N. E. Ill., p. 142); Michigan, occasional (Gibbs, p. 495). Michigan (Cook, Mich., p. 41). Ridgway, Ill. Orn., II., p. 177.

Subgenus *ERIONETTA* COUES.**23. (162). *Somateria spectabilis* (LINN.).****King Eider.**

Illinois and Wisconsin, rare winter visitor (Nelson, N. E. Ill., p. 143); Ohio (Wheaton, p. 535). Michigan and Wisconsin, Kumlein (Cook, Mich.; Ridgway, Ill. Orn., II., p. 178).

GENUS *OIDEMIA* FLEMING.SUBGENUS *OIDEMIA*.**24. (163). *Oidemia americana* SW. & RICH.****American Scoter.**

Illinois, winter resident (Nelson, N. E. Ill., p. 143); Michigan, rare (Gibbs, p. 494). Lake Michigan. Bay City, female (Cook, Mich., p. 41). Ridgway, Ill., II., p. 180. Ohio (Wheaton), pp. 537-8.

GENUS *NOMONYX* RIDGWAY.**25. (168). *Nomonyx dominicus* (LINN.)****Masked Duck.**

A tropical species, accidental in New York and Wisconsin (Ridgway Manual, p. 114).

SUBFAMILY ANSERINÆ. GEESE.

GENUS *BRANTA* SCOPOLI.**26. (172b). *Branta canadensis occidentalis* (BAIRD).****White-cheeked Goose.**

Michigan (Cook, Mich., p. 47).

27. (172c). *Branta canadensis minima* RIDGW.**Cackling Goose.**

Illinois (Bull. Nutt. Orn. Club, 1876, p. 41); Ridgway, Ill. Orn., II., pp. 123-4; Wisconsin (Ridgway Manual, 1887, p. 117). A specimen from Wisconsin presented to Smithsonian Institution by Mr. G. F. Morcom (Deane, in Manuscript).

FAMILY IBIDIDÆ. IBISES.

GENUS *PLEGADIS* KAUP.**28. (186). *Plegadis autumnalis* (HASSELQ.).****Glossy Ibis.**

Illinois, rare (Ridgway Cat., p. 192); Ohio, accidental (Wheaton, p. 498). Michigan (Cook, Mich., p. 48).

FAMILY ARDEIDÆ. HERONS, BITTERNS, ETC.

SUBFAMILY BOTAURINÆ. BITTERNS.

GENUS ARDETTA GRAY.

29. (191.1). *Ardetta neoxena* CORY.

Cory's Least Bittern.

August 8, 1894. Manchester, Mich. A specimen of this rare species was brought to Mr. L. Whitney Watkins by a neighbor's boy. Mr. Watkins at once wrote me of the peculiar dark Least Bittern that he had received. I suspected its identity and requested that he send it to me for examination. It had, however, been forwarded to Prof. W. B. Barrows, Agr. Coll., Mich. He determined it to be Cory's Bittern. It will be noted that six of those known have been taken in Florida and the other three north of the latitude of the northern boundary of Indiana.

The bird may be reasonably expected to occur in Indiana. Its dark color gives it the name of "Black Bittern" in Florida, to distinguish it from the "Least Bittern," which is called "Brown Bittern." They are about the same size.

SUBFAMILY ARDEINÆ. HERONS AND EGRETS.

GENUS ARDEA LINNEUS.

Subgenus ARDEA.

30. (198). *Ardea rufescens* GMEL.

Reddish Egret.

Illinois, summer visitor southward (Nelson, S. Ill., p. 60).

FAMILY RECURVIROSTRIDÆ. AVOCETS AND STILTS.

GENUS HIMANTOPUS BRISSON.

31. (226). *Himantopus mexicanus* (MÜLL.).

Black-necked Stilt.

Illinois and Wisconsin, rare (Nelson, N. E. Ill., p. 124). Ridgway. Ill. Orn., II., p. 76. Ohio, rare (Wheaton, p. 463); Michigan, rare (Gibbs, p. 492). Cook, Mich., p. 57.

FAMILY SCOLOPACIDÆ. SNIPES, SANDPIPERS, ETC.

GENUS TRINGA LINNÆUS.

Subgenus ARQUATELLA Baird.

32. (235). *Tringa maritima* BRÜNN.**Purple Sandpiper.**

Illinois, rare (Ridgway Cat., p. 195); Ohio, rare (Wheaton, p. 476).
Cook Co., Ill., Auk, April, 1896, p. 180.

Subgenus ACTODROMAS Kaup.

33. (240). *Tringa fuscicollis* VIEILL.**White-rumped Sandpiper.**

Illinois and Wisconsin (Nelson, N. E. Ill., p. 127); Ohio, migrant (Wheaton, p. 475); Michigan, rare (Gibbs, p. 492; Cook, p. 59). Cincinnati, two specimens. Glendale, O., September 6, 1879. (Journal Cincinnati Society Natural History, July 8, p. 127.)

34. (244). *Tringa ferruginea* BRÜNN.**Curlew Sandpiper.**

Michigan (Cook, Mich., p. 59).

GENUS EREUNETES ILLIGER.

35. (247). *Ereunetes occidentalis* LAWR.**Western Sandpiper.**

Illinois (Ridgway, Ill. Orn., II., p. 54).

GENUS PAVONCELLA LEACH.

36. (260). *Pavoncella pugnax* (LINN.).**Buff.**

A European species, accidental in Ohio (Wheaton, p. 489).

GENUS TRYNGITES CABANIS.

37. (262). *Tryngites subruficollis* (VIEILL.).**Buff-breasted Sandpiper.**

Illinois and Wisconsin (Nelson, N. E. Ill., p. 130); Ohio (Wheaton, p. 491); Michigan, rare (Gibbs, p. 493). Cook Co., Ill., Auk, April, 1896, p. 180.

FAMILY TETRAONIDÆ. GROUSE, PARTRIDGES, ETC.

SUBFAMILY TETRAONINÆ. GROUSE.

GENUS DENDRAGAPUS ELLIOT.

38. (298). *Dendragapus canadensis* (LINN.).**Canada Grouse.**

Michigan, as far south as Washtenaw County (Cook, Mich., p. 67).

GENUS LAGOPUS BRISSON.

39. (301). *Lagopus lagopus* (LINN.).**Willow Ptarmigan.**

Illinois and Wisconsin, former resident (Nelson, N. E. Ill., p. 122); Michigan (Gibbs, p. 491; Cook, p. 68). Ridgway, Ill. Orn., II., pp. 10-11.

GENUS PEDIOCAETES BAIRD.

40. (308b). *Pediocaetes phasianellus campestris* RIDGW.**Prairie Sharp-tailed Grouse.**

Illinois, rare (Ridgway Cat., p. 191). Lower Peninsula, Mich. (Cook, p. 69). Ridgway, Ill. Orn., II., pp. 13-14.

FAMILY FALCONIDÆ. VULTURES, FALCONS, HAWKS, ETC.

SUBFAMILY ACCIPITRINÆ. KITES, BUZZARDS, HAWKS, ETC.

GENUS ELANUS SAVIGNY.

41. (328). *Elanus leucurus* (VIEILL.).**White-tailed Kite.**

Illinois, breeds (Nelson, S. Ill., p. 46); Michigan, rare (Gibbs, p. 490). Four records (Cook, Mich., p. 72). Ridgway, Ill. Orn., I., pp. 446-7. Two specimens.

GENUS BUTEO CUVIER.

42. (337a). *Buteo borealis krideri* HOOPES.**Krider's Hawk.**

Illinois, accidental (H. K. Coale, see Ridgway, Ill. Orn., I., p. 469).

43. (337b). *Buteo borealis calurus* (CASS.).**Western Red-tailed Hawk.**

Illinois (Ridgway Cat., p. 189; Ridgway, Ill. Orn., I., p. 469); Michigan (Gibbs, p. 490).

44. (342). *Buteo swainsoni* BONAP.**Swainson's Hawk.**

Illinois (Ridgway Cat., p. 189); Michigan (Gibbs, p. 490; Bull. No. 1, Mich. Orn. Club; Cook, Mich., p. 75). Given by Dr. Jordan as from Indiana (Manual, p. 113), but he informs us that this is an error. Ridgway, Ill. Orn., I., pp. 474-5.

GENUS *ASTURNIA* VIEILLOT.**45. (346). *Asturnia plagiata* SCHLEGEL.****Mexican Goshawk.**

Illinois, accidental; one specimen (Ridgway, Ill. Orn., I., p. 463).

GENUS *ARCHIBUTEO* BREHM.**46. (348). *Archibuteo ferrugineus* (LIGHT).****Ferruginous Rough-leg.**

Illinois, straggler (Ridgway, Ill. Orn., I., pp. 481, 482).

SUBFAMILY *FALCONINÆ*. FALCONS.GENUS *FALCO* LINNÆUS.Subgenus *HIRROFALCO* Cuvier.**47. (354a). *Falco rusticolus gyrfalco* (L.).****Gyrfalcon.**

Michigan (Cook, Mich., p. 77).

48. (355). *Falco mexicanus* SCHLEG.**Prairie Falcon.**

Illinois, accidental; three records near Mt. Carmel (Ridgway, Ill. Orn., I., pp. 429-31).

FAMILY *BUBONIDÆ*. HORNED OWLS, ETC.GENUS *NYCTALA* BREHM.**49. (371). *Nyctala tengmalmi richardsoni* (BONAP.).****Richardson's Owl.**

Has been taken in Illinois and Wisconsin (Ridgway, Ill. Orn., I., p. 413). It was reported from Indiana, but that, I am informed, is an error. Michigan, no record (Cook, Mich., p. 81).

GENUS BUBO DUMERIL.

50. (375a). *Bubo virginianus subarcticus* (Hoy).**Western Horned Owl.**

Illinois, occasional in winter (Ridgway, Ill. Orn., I., p. 421). ~~One~~ record. No record, Michigan (Cook, Mich., p. 83).

FAMILY PICIDÆ. WOODPECKERS.

GENUS PICOIDES LACEPEDE.

51. (400). *Picoides arcticus* (SWAINS.).**Arctic Three-toed Woodpecker.**

Synonym, BLACK-BACKED THREE-TOED WOODPECKER.

Illinois, rare winter visitor (Nelson, N. E. Ill., p. 115; Ridgway, Ill. Orn., I., pp. 379-80); Ohio, accidental (Wheaton, p. 397); Michigan, rare (Gibbs, p. 489; Cook, Mich., p. 88). Kent and Ionia counties.

52. (401). *Picoides americanus* BREHM.**American Three-toed Woodpecker.**

Michigan (Cook, Mich., p. 88); Wisconsin (O. B. Warren, in letter).

FAMILY CAPRIMULGIDÆ. GOATSUCKERS, ETC.

GENUS CHORDEILES SWAINSON.

53. (420a). *Chordeiles virginianus henryi* (CASS).**Western Nighthawk.**

Illinois, occasional (Ridgway, Ill. Orn., I., p. 370).

FAMILY TYRANNIDÆ. TYRANT FLYCATCHERS.

GENUS MILVULUS SWAINSON.

54. (442). *Milvulus tyrannus* (LINN.).**Fork-tailed Flycatcher.**

A tropical species, accidental in Kentucky (Ridgway Manual, p. 327).

55. (443). *Milvulus forficatus* (GMEL.).**Scissor-tailed Flycatcher.**

Accidental in Missouri, New England, Manitoba, etc. (Ridgway Manual, p. 328).

GENUS SAYORNIS BONAPARTE.

56. (457). Sayornis saya (BONAP.).**Say's Phoebe.**

Illinois and Wisconsin (Nelson, N. E. Ill., p. 113); Michigan (Gibbs, p. 488). Not in Mich., Cook. Ridgway, Ill. Orn., I., p. 348.

FAMILY ALAUDIDÆ. LARKS.

GENUS ALAUDA LINNÆUS.

57. (473). Alauda arvensis LINN.**Skylark.**

Ohio, introduced in the vicinity of Cincinnati, but it seems doubtful if it will succeed in establishing itself in this country. (Langdon, Journ. Cin. Soc. Nat. Hist., Vol. I., 1878, p. 111.)

FAMILY CORVIDÆ. CROWS, JAYS, MAGPIES, ETC.

SUBFAMILY GARRULINÆ. MAGPIES AND JAYS.

GENUS PICA BRISSON.

58. (475). Pica pica hudsonica (SAB.).**American Magpie.**

Illinois and Wisconsin, a former winter visitor (Nelson, N. E. Ill., p. 112); Cook, Mich., p. 99. Michigan (?) (Ridgway Manual, p. 352). Ridgway, Ill. Orn., I., pp. 333-4. J. O. Dunn. One specimen identified by Wallace Craig, October 17, 1892, near World's Fair, Chicago.

GENUS PERISOREUS BONAPARTE.

59. (484). Perisoreus canadensis (LINN.).**Canada Jay.**

Illinois and Wisconsin, former winter visitor (Nelson, N. E. Ill., p. 113); Michigan, breeds (Gibbs, p. 848); has been reported from Ohio, but that is an error (Wheaton, p. 366).

FAMILY ICTERIDÆ. BLACKBIRDS, ORIOLES, ETC.

GENUS STURNELLA VIEILLLOT.

60. (501b). Sturnella magna neglecta (AUD.).**Western Meadow Lark.**

Illinois (Ridgway, Ill. Orn., Vol. I., p. 318); Michigan (Gibbs, p. 488; Cook, Mich., p. 103).

GENUS SCOLECOPHAGUS SWAINSON.

61. (510). *Scolecophagus cyanocephalus* (WAGL.).**Brewer's Blackbird.**

Illinois, Mt. Carmel, straggler (Ridgway, Ill. Orn., I., p. 324).

FAMILY FRINGILLIDÆ. FINCHES, SPARROWS, ETC.

GENUS ACANTHIS BECHSTEIN.

62. (527a). *Acanthis hornemannii exilipes* (COUES.)**Hoary Redpoll.**

Illinois, rare winter visitor (Ridgway, Ill. Orn., I., p. 232); Michigan (Gibbs, p. 486). Omitted by Cook.

GENUS SPINUS KOCH.

63. (532). *Spinus notatus* (DE BUS).**Black-headed Goldfinch.**

A Mexican and Central American species, accidental in Kentucky (Ridgway Manual, p. 400).

GENUS RHYNCHOPHANES BAIRD.

64. (539). *Rhynchophanes mccownii* (LAWR.).**McCown's Longspur.**

Illinois, straggler (Ridgway, Ill. Orn., I., p. 246). Not in Michigan.

GENUS ZONOTRICHIA SWAINSON.

65. (553). *Zonotrichia querula* (NUTT.).**Harris' Sparrow.**

Illinois and Wisconsin, rare winter visitor (Ridgway, Ill. Orn., I., pp. 266-7).

J. O. Dunn shot a Harris Sparrow in some bushes along a road, east of Riverdale, Ill., October 6, 1894. Letter, January 26, 1895.

66. (554a.) *Zonotrichia leucophrys intermedia* RIDGW.**Intermediate Sparrow.**

Wisconsin, accidental (Nelson, N. E. Ill., p. 107).

67. (557.) *Zonotrichia coronata* (PALL.).**Golden-crowned Sparrow.**

Wisconsin, accidental (Nelson, N. E. Ill., p. 108).

GENUS *PIPILO* VIEILLLOT.**68. (588). *Pipilo maculatus arcticus* (SWAINS.).****Arctic Towhee.**

Wisconsin, two specimens (Nelson, N. E. Ill., p. 110).

GENUS *HABIA* REICHENBACH.**69. (596). *Habia melanocephala* (SWAINS.).****Black-headed Grosbeak.**

Michigan, very rare (Gibbs, p. 487).

GENUS *PASSERINA* VIEILLLOT.**70. (600). *Passerina versicolor* (BON.).****Varied Bunting.**

Michigan, one specimen by Dr. H. A. Atkins (Cook, Birds of Michigan, p. 118).

71. (601). *Passerina ciris* (LINN.).**Painted Bunting.**

Illinois, Wabash County, rare (Ridgway, Ill. Orn., I., p. 302).

FAMILY VIREONIDÆ. VIREOS.

GENUS *VIREO* VIEILLLOT.Subgenus *VIREO*.**72. (633). *Vireo bellii* AUD.****Bell's Vireo.**

Illinois, summer resident in prairie districts (Ridgway, Ill. Orn., I., pp. 190-91). Richland County, June 8, 1871, and 1875. One specimen in Chicago, June 23, 1875.

FAMILY MNIOTILTIDÆ. WOOD WARBLERS.

GENUS *HELMINTHOPHILA* RIDGWAY.**73. (—). *Helminthophila leucobronchialis* (BREWST.).****Brewster's Warbler.**

A rare and peculiar Warbler, found in eastern United States, west into Michigan (Gibbs, p. 483; Ridgway Manual, p. 486).

74. (—). *Helminthophila cincinnatiensis* (LANGD.).**Cincinnati Warbler.**

Only known from one specimen from Cincinnati, O. (Journ. Cin. Soc. Nat. Hist., July, 1880, pp. 119-120). This is supposed to be a hybrid, between *Helminthophila pinus* and *Oporornis formosa* (Bull. Nutt. Orn. Club, Vol. V., 1880, p. 237).

GENUS DENDROICA GRAY.

Subgenus DENDROICA.

75. (672a). *Dendroica palmarum hypochrysea* RIDGW.**Yellow Palm Warbler.**

One specimen, Oberlin, O., April 16, 1892 (Auk, October, 1892, p. 397).

FAMILY PARIDÆ. NUTHATCHES AND TITS.

SUBFAMILY SITTINÆ. NUTHATCHES.

GENUS SITTA LINNÆUS.

76. (729). *Sitta pusilla* LATH.**Brown-headed Nuthatch.**

Ohio and Michigan, accidental (Wheaton, p. 226); St. Louis, Mo., (Ridgway, Ill. Orn., I., p. 83).

SUBFAMILY PARINÆ. TITMICE.

GENUS PARUS LINNÆUS.

Subgenus PARUS.

77. (740). *Parus hudsonicus* FORST.**Hudsonian Chickadee.**

Illinois, Rock Island, accidental. Racine, Wis. (Ridgway, Ill. Orn., I., p. 82); Michigan (Ridgway Manual, p. 564; Cook, Mich., p. 147).

FAMILY TURDIDÆ. THRUSHES, SOLITAIRES, BLUEBIRDS, ETC.

SUBFAMILY MYADESTINÆ. SOLITAIRES.

GENUS MYADESTES SWAINSON.

78. (754). *Myadestes townsendii* (AUD.)**Townsend's Solitaire.**

Illinois, accidental northward (Nelson, N. E. Ill., p. 94).

SUBFAMILY TURDINÆ. THRUSHES.

GENUS TURDUS LINNÆUS.

Subgenus HYLOCICHLA Baird.

79. (757a). *Turdus aliciae bicknelli* (RIDGW.).**Bicknell's Thrush.**

Illinois, rare in spring (Ridgway, Ill. Orn., I., p. 59). Warsaw, Ill., May 24, 1884, by Chas. K. Worthen.

GENUS SAXICOLA BECHSTEIN.

80. (765). *Saxicola œnanthe* (LINN.).**Wheatear.**

A specimen of this species was shot from among a flock of Titlarks at Ann Arbor, Mich., October 4, 1894, by Adolphe B. Covert. The specimen is now in the U. S. Nat. Mus., Washington, D. C.—No. 135,068, male, immature. (The Nidologist, Vol. II., No. 3, November, 1894, pp. 42-43.)

GENUS SIALIA SWAINSON.

81. (768). *Sialia arctica* (SWAINS.)**Mountain Bluebird.**

Iowa, accidental (Nelson, N. E. Ill., p. 95).

The following species have been reported from a range which would seem to include Indiana, but should properly be excluded from the Hypothetical List:

1. (—). *Colymbus cristatus* LATH.**Crested Grebe.**

An Old World species, wrongfully accredited to America.

2. (336). *Buteo buteo* (LINN.).**European Buzzard.**

A European species, attributed to Michigan. Perhaps an error.

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